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A REVIEW ARTICLE ON COLLOIDAL DISPERTIONS

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abstract:
colloids are crucial to both ordinary living and pharmacological formulations. the study of both big molecules and intricately divided multiphase systems is known as colloidal science. the intersection of colloid and surface science is the multi-phase system. a colloid is a mixture in which one material is suspended within another substance and has insoluble particles scattered over a tiny scale. between genuine solutions and suspensions, colloidal solutions or colloidal dispersions represent a middle ground. the dispersed phase of colloids is distributed throughout the dispersion medium. in many facets of chemistry, colloidal chemistry knowledge is necessary. this article provides information on what colloids are, their types, sizes, forms, qualities, and uses.

keywords: colloid, colloidal system, colloidal dispersions, colloidal particles.

introduction:
the words "kolloid" and "oid" are derived from the greek word "kolla," which means "glue," and "like," respectively. a colloidal dispersion is homogenous in nature and consists of two phases, the internal phase of which is dispersed into the external phase of the dispersion medium and has a size range of 1 nanometer to 1 micrometer. the finest illustration is when silver chloride precipitates and forms colloidal dispersion as a byproduct. ions cannot congregate over great distances and form massive crystals because the precipitation reaction proceeds too quickly. small particles that remain suspended in the liquid are formed when the ions group together for instance, in a real solution of sugar or salt in water, the solute particles are disseminated as single molecules or ions throughout the solvent. as a result, the scattered particles' diameters range from 1 to 10. on the other hand, aggregates of millions of molecules make up the dispersed particles in a sand suspension that has been swirled into water. these particles have a diameter of at least 2,000 nm. the distinction between real solutions and colloidal solutions cannot, of course, be drawn. as the size is lowered, colloidal behavior can be associated with a significantly higher surface area compared to the volume. the important characteristics of colloidal dispersions can be attributed to the extremely high surface area to volume ratio of the particles. there is no genuine surface of separation between the molecular particles of solute and solvent in a true solution, which simply consists of one phase. particle size in the colloidal state ranges from 5 to 200 micrometers. in a highly dispersed system known as a colloidal system, the dispersed particles are aggregates of numerous molecules rather than individual molecules. the nanoscale (10-9 m) to micrometer (10-6 m) range is the size range. the line dividing colloidal systems from non-colloidal systems is not particularly clear. the presence of a colloidal system is typically caused by the nature of the materials that are dissolved in the medium and is independent of aggregation, chemical composition, and source. surface science includes colloid science. instead of doing research on the colloidal systems themselves, the surface interfacial phenomena connected to colloidal systems such emulsions and forms are frequently explored.

the phase that creates the particles is known as the dispersed phase. the medium in which particle dispersion occurs is referred to as the dispersion media. a dispersed phase and the dispersion medium make up a colloidal system, as was already mentioned. there are eight different kinds of colloidal systems since either the dispersed phase or the dispersion medium might be a gas, liquid, or solid. it is impossible to colloidally disperse one gas into another since doing so would result in a homogeneous molecular combination. the several kinds of colloidal systems are listed as follows:

dispersed phase	**dispersion medium**	**colloidal system**	**examples**
solid	gas	solid aerosol	smoke, volcanic dust
liquid	gas	liquid aerosol	clouds, fogs, mists
gas	liquid	foam or froth	whipped froth, soap lather, soda water
solid	liquid	sols	albumin in water, paints, ink
liquid	liquid	emulsions	milk
gas	solid	solid foam	foam rubber, pumice stone
solid	solid	solid sols	ruby glass, alloys
liquid	solid	gels	jellies, butter, curd

- **classification based on interaction between colloidal dispersion:**

***1)lyophilic colloids*: (**solvent-loving):

lyophilic (solvent-loving) colloids are systems having colloidal particles that interact significantly with the dispersion medium. colloids are said to as hydrophilic if the solvent is water. the most common method for creating lyophilic colloidal sols is to simply dissolve the substance in the solvent being employed. for instance, a sol is created when gelatin, acacia, or celluloid are dissolved in water or amyl acetate, respectively.

***2)lyophobic colloids*:** (solvent-hating):

these are systems where there is less attraction between the particles and the solvent. water serves as the solvent in the case of hydrophobic colloids. inorganic particles scattered in water make up lyophobic colloids in general. these materials include, but are not limited to, gold, silver, sulphur, arsenous sulphide, silver iodide, etc.

***3)association colloids*:** (amphiphilic):

these are the amphiphilic molecules in the colloidal system. both polar and non-polar groups are present. the production of micelles occurs as concentration is raised. critical micellar concentration (cmc) refers to the quantity of monomer micelles that form. soaps and artificial detergents are two examples of linked colloids.

- **preparation of colloids:**

there are two principal ways of preparation of colloids:

a: using shear, spraying, or milling to disperse big particles or drops to colloidal dimensions (e.g., shaking, mixing, or high shear mixing).

b: the formation of bigger colloidal particles from smaller dissolved molecules through precipitation, condensation, or redox processes. gold or colloidal silica are prepared using these techniques.

I. **chemical methods of preparation of colloids of preparation of colloids:**

hydrophilic or lyophobic colloidal solutions can be prepared by various chemical techniques such as:

1.arsenious chloride is produced when hydrogen sulphide is passed through an arsenious oxide solution that has been dissolved in distilled water.

3h2s + as2o3 = 3h2s + as2s3

2. sulfur dioxide is oxidized by forcing a colloidal sulphur solution through an aqueous solution of sulphur dioxide. it can also be obtained by putting the gas through a solution of nitric acid and an oxidizing agent like bromine water.

2h2o + 3s = so2 + 2h2s

h2o + s = h2s + [o]

3. reduction technique - this method involves using a reducing agent to reduce the salt solutions of the metals, such as silver, gold, and platinum, before preparing the colloidal solutions. the reducing agent stannous chloride is an example.

4. the hydrolysis method uses boiling water to create a ferric chloride reduced solution: fecl3 + 3h2o → fe(oh)3 + 3 hcl

II. **physical methods of preparation:**

colloidal dispersions can also be produced using a variety of physical techniques. some of them consist of

1. ***exchange of solvent :***
   it entails adding an element's alcoholic solution to extra water in order to create a colloidal solution of that element. only when an element is more soluble in alcohol than in water can colloidal formation occur. a colloidal solution of sulphur is produced when extra water is allowed to pass through an alcohol-based sulphur solution. this is due to the fact that sulphate is more soluble in water than it is in alcohol.

2. the technique involving excessive cooling:

using this method, colloidal solutions of ice are created by freezing a solution of water in an organic solvent, such as ether, chloroform, etc. water molecules unite to form colloidal molecules because they are unable to exist individually.

3.dispersion techniques:

these involve peptization and electrical breakdown.

a) electrical disintegration:

is the result of condensation and dispersion working together? the most frequent application of this method is the creation of colloidal solutions of various metals, including gold, silver, platinum, etc. two metal electrodes immersed in a dispersion solution are used in this process. some of the metal is vaporised by an electrical arc that produces a great deal of heat. condensed vapours result in precipitates of colloidal dimensions.

b) peptization:

by agitating the precipitate with a dispersion medium while a small amount of a peptization agent is present, the precipitate can be changed into a colloidal state. it functions as an electrolyte to transform recent precipitation into a colloidal solution. colloidal particle aggregates held together by weak forces make up such precipitates.

properties of colloids:

a] <u>kinetic properties of colloids:</u>

kinetic properties of colloidal systems relate to the motion of particles with respect to the dispersion medium. these properties are given by:

1)Brownian motion: Brownian motion or movement is the constant, swift zig-zagging motion that a colloidal particle makes in the dispersion medium. sir "Robert brown," who made the discovery in 1827, is honored with the name of this phenomena. true solutions and suspension don't show Brownian movement. due to the particles being bombarded by the molecules of the dispersion medium, Brownian motion is particularly evident in particles smaller than 5 mm. because of its modest size, it cannot be seen. with a reduction in particle size, the particle's velocity rises. by adding glycerin or other viscosifying chemicals to the media, Brownian movement can be inhibited. Brownian motion or movement is the constant, swift zig-zagging motion that a colloidal particle makes in the dispersion medium. after sir Robert brown, who made the discovery in 1827, this phenomenon has that name. true solutions and suspension don't show Brownian movement.

2)diffusion:

diffusion is another kinetic property of colloid which occur as a result of Brownian movement. here particles get diffused spontaneously from a region of higher concentration to one of lower concentration until the concentration of system is uniform throughout. according to Fick's 1st law, the amount does of a substance diffusing in time dt across an area s is directly proportional to charge of concentration dc with distance dx, d is the diffusion coefficient diffusion coefficient may be obtained in colloidal chemistry by diffusion experiments in which the material is allowed to pass through a porous disc and samples are removed and analyzed periodically. if the colloidal particles are assumed to be spherical, the following equation is used to obtain radius of the particle and molecular weight.

3)osmotic pressure:

osmosis is the movement of particles against a concentration gradient via a semipermeable membrane. in that case, the osmotic pressure is the lowest pressure required to negate osmosis.

4)sedimentation:

the tendency for particles in suspension to separate from the fluid in which they are entrained and rest up against a barrier is known as sedimentation. this is a result of their movement through the fluid in reaction to forces acting on them, which may be brought on by electromagnetism, centrifugal acceleration, or gravity. the lower size limit of particles obeying stoke's equation is around 0.5 mm if the particles are merely subjected to the force of gravity. this is owing to the fact that brownian movement has grown important, has a tendency to counteract gravitational sedimentation, and encourages mixing. 50 in order to cause the sedimentation of colloidal particles, a larger force must be used. svedberg's invention, the ultra-centrifuge, enables this.

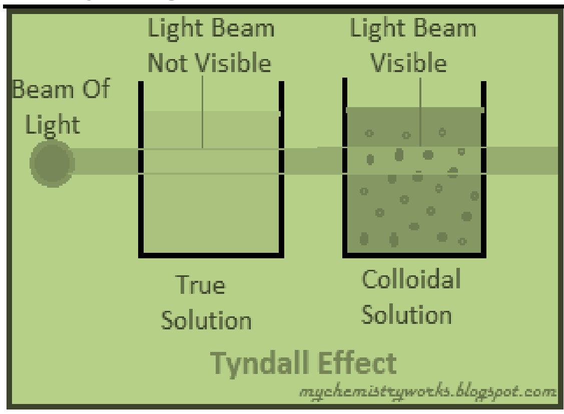
5)viscosity:

viscosity is an expression of a system's resistance to flow when a stress is applied. the amount of applied force necessary to cause a liquid to flow at a specific pace increases with the viscosity of the liquid. the flow characteristics of diluted colloidal systems and the method for determining the molecular weight of the substance making up the disperse phase using viscosity data.

<u>b] optical properties of colloids:</u> optical properties are given as follows-

1)the faraday–Tyndall effect:

a visible cone is created when a strong light beam is conducted through a colloidal sol because the colloidal particles scatter the light. the faraday-Tyndall effect is this. Zsigmondy's ultramicroscope makes it possible to look at the light points that produce the Tyndall cone. although the particles themselves cannot be seen directly when a powerful light beam is conducted through the sol against a black background at right angles to the plane of sight, the brilliant spots corresponding to the particles can be seen and counted.



3)ultramicroscopic nature of particles:

a microscope cannot reveal sol particles. Zsigmondy created the ultramicroscope by utilizing the Tyndall phenomenon. a sol in a glass container is the focus of a powerful light beam. a microscope is then pointed at the light focus at a right angle to the beam to observe it. against a dark background, individual sol particles appear as dazzling flecks of light (dispersion medium). it should be highlighted that the real particles are not visible under the ultramicroscope. what can be seen are the more pronounced light haloes that surround the particles. consequently, an ultramicroscope cannot provide information about the size and shape of the sol particles.

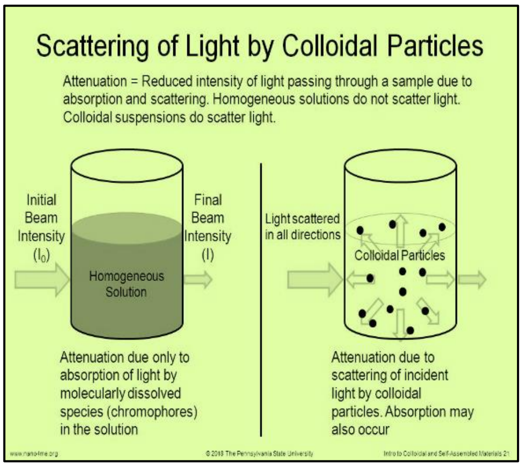
4)electron microscope:

: the lowest distance at which two objects can be separated and yet be distinguished, or d, is the electron microscope's high resolving power. the lower the wavelength of the radiation employed, the stronger the resolving power and smaller the value of d. the optical microscope can only distinguish between two particles that are separated by around 20 nm (200) and employs visible light as its radiation source. the electron microscope's radiation comes from a stream of highly energetic electrons

with wavelengths of 0.01 nm (0.1). this leads in d being roughly 0.5 nm (5) with present equipment, which is a significantly higher power of resolution than the optical microscope. with the use of this equipment, we may get an understanding of the size and form of a variety of microscopic particles, including bacteria, viruses, and paint pigments. these particles have been identified as spherical, rod-, disc-, or long filamentous structures.

5)light scattering:

a colloidal medium causes some light to be absorbed, some to be scattered, and some to be transmitted as a beam of light passes through it.



c] electrical property of colloids:

1)electrical double layer: by selectively adsorbing a coating of positive ions around it, a colloidal particle's surface gains a positive charge. the medium's counter-ions are drawn to this layer, creating a second layer of negative charges. Helmholtz double layer refers to the combination of the two layers of +ve and -ve charges around the sol particle. Helmholtz believed that while the layers of negative charges surrounding the medium were mobile, the positive charges near to the particle surface were stationary. recent studies have revealed that the double layer is composed of the following: (a) compact layer of positive and negative charges that are firmly bound to the particle surface. (b) the introduction of a diffuse layer of counterions (negative ions) into the positive ion-containing media.

2)***electroosmosis:***

in terms of basic principles, electroosmosis and electrophoresis are mutually exclusive. in the latter, when a potential is applied, a charged particle is made to move in relation to a stationary liquid. however, the liquid now moves in relation to the charged surface if the solid is rendered immobile (for example, by creating a capillary or turning the particles into a porous plug). this process is known as electroosmosis, so named because liquid passes through a membrane or plug when a potential is applied to it. another approach for assessing the zeta potential is electroosmosis, which works by measuring the rate at which liquid flows through the plug under typical circumstances.

3)***sedimentation potential:***

when particles go through sedimentation, which is the opposite of electrophoresis, a potential is created. when dispersed particles move through a medium as a result of gravity or centrifugation, sedimentation potential is present. the double layer of the particle's equilibrium symmetry is broken by this motion. the ions in the electric double layer move with the particle, but the liquid flow causes them to lag behind. the electric charge of the diffuse layer and the surface charge are slightly displaced as a result. the outcome is a dipole moment produced by the travelling particle. sedimentation potential is the name given to the electric field produced by the sum of all the dipoles.

4)streaming potential:

electroosmosis is the reverse of streaming potential. an electrical potential difference will be created between the two ends of a stationary capillary or porous plug when an electrolyte solution is pushed to flow through it. the term "streaming potential" refers to this electrical potential difference, which means that the liquid carries away the ions with the charge opposite to the surface. this causes a streaming current, which in turn causes charge to build up at the ends and create an electrical field.

5)donnan membrane equilibrium (gibbs–donnan equilibrium):

it exists in a membrane-separated region between two solutions. the membrane is designed to let the passage of some of the charged (ions) elements of the solutions. if a negatively charged colloid and its counterions r-na+ are placed on one side of a semipermeable membrane with sodium chloride in solution on the other side, the sodium and chloride ions can freely cross the barrier but not the colloidal anionic particles. r- is the non-diffusible colloidal anion in the equilibrium system, and the semipermeable membrane is symbolized by the vertical line separating the various species.it is assumed that the volumes of solution on the two sides of the membrane are equal. evidently, the osmotic pressures of polyelectrolyte solutions will be incorrect due to the uneven distribution of diffusible electrolyte ions on the two sides of the membrane. however, the donnan equilibrium effect can virtually be avoided when determining the molecular weights of proteins using the osmotic pressure method by increasing the concentration of salt in the solution.

- **applications of colloids:**

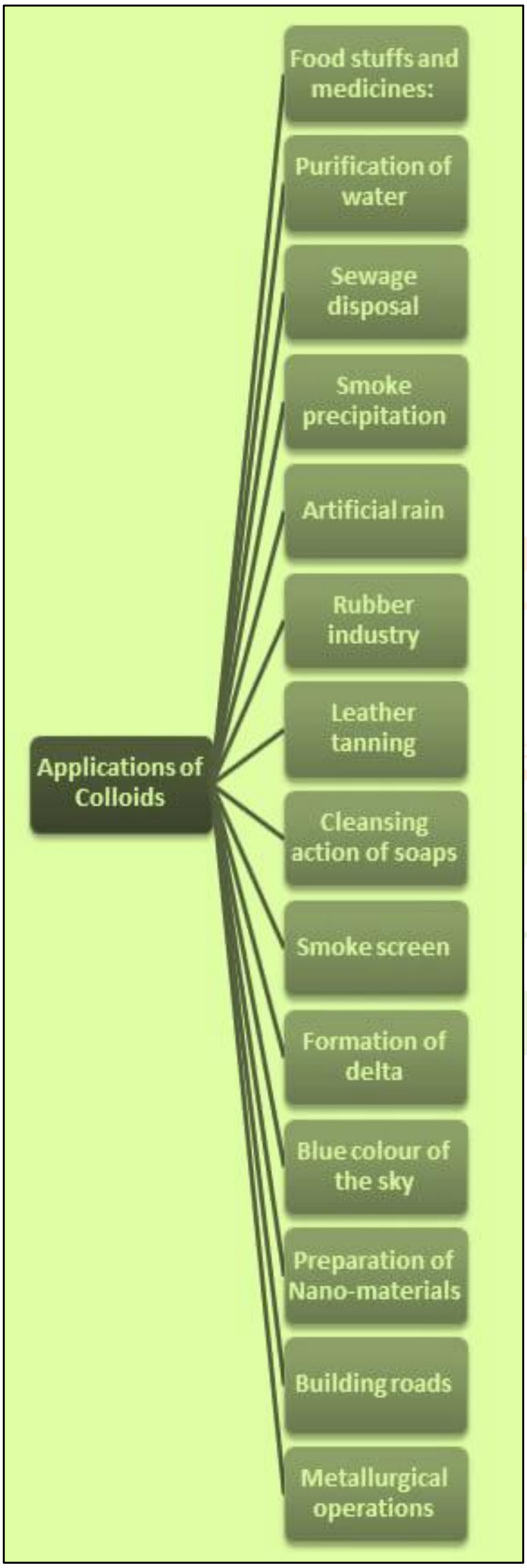
in our daily lives, colloids are used in a wide range of things, from food to pharmaceuticals to industries. the list below includes a few uses for colloids.

1)water purification:

we are aware that the addition of electrolytes like potash alum is one of the most often utilized techniques for water filtration. the fact that these electrolytes must be added is justified by the fact that dirty water typically has a colloidal system. it typically has dispersed colloidal particles that filtering cannot get rid of. when these electrolytes are added, the contaminant coagulates and can be removed by filtration.

2)smoke precipitation:

smoke is another type of colloidal system that mostly consists of charged carbon atoms that are depressed in the atmosphere. because it is the primary cause of air pollution, smoke poses a serious threat to the environment. the issue can be resolved by removing the airborne colloidal particles that have become distributed. once more, electrophoresis is utilized for this. in Cottrell precipitator, this is carried out. smoke is circulated through a chamber that has several metal plates attached to a metal frame.



3)***food and medicines***:

colloids are widely used in the food industry and in culinary products. the majority of the dietary components we consume are colloidal in nature. colloids include milk and a variety of dairy products like cheese, cream, and butter. specifically, milk is an emulsion (liquid in liquid colloidal system). butter and fat are dissolved in water and present in milk. the cooked dough of bread is a colloidal system in which air is disseminated. additionally, colloids are used in the creation of pharmaceuticals. due to its ease of absorption by the body, colloidal medicines are more effective than comparable medications. many drugs are emulsions in this manner. colloidal sol, a form of several powerful antibiotics including penicillin and streptomycin, is injected into the body to increase absorption.

4)***sewage disposal:***

as was already said, sewage water contains contaminants like mud and grit that are spread throughout the water and have a colloidal size. the impurities (colloidal particles) in sewage are charged particles, much like any other colloidal system. by using electrophoresis, these charged impurity particles found in sewage may be eliminated. the sewage water is routed via a tunnel equipped with metallic electrodes and kept at a high potential difference for this purpose. the charged impurity particles in the sewage water move to the electrodes with the opposing charges, which causes them to coagulate.

5)artificial rain:

colloidal systems include clouds as well. in clouds, dust particles and water vapors are mixed together. the water molecules in a cloud are colloidal in size and carry an electric charge. therefore, they will begin to rain if the charge on the molecules is somehow neutralized. the rain that results from doing this is sometimes referred to as artificial rain. it is sometimes accomplished by spraying some electrolytes over the clouds.

6)***rubber industry:*** you must be aware that the latex from rubber trees is used to make synthetic rubber. this latex is an emulsion made of water and negatively charged rubber particles. this latex is heated to create rubber, which causes the rubber particles to coagulate. it is vulcanized to harden this coagulated substance into natural rubber.

7)***leather tanning:***

animal skins are subjected to a procedure called tanning in order to produce leather. animal skin is a colloidal system that contains positively charged colloidal particles. during the procedure, tannin and some negatively charged aluminum and chromium chemicals are used to coagulate the charged skin particles. colloidal qualities are used in the tanning of leather. giant molecules are organized in long, twisted strands in raw skins. the colloidal state of tannin, which includes chromium and aluminum compounds as well as tannin, allows the positively charged protein fibers to absorb the negative charges from the metallic components.

8)cleansing action of soaps:

a soap solution is a colloidal system that eliminates oil and grime by creating emulsions that are soluble in water.

9)***smoke screen:***

when something needs to be hidden, smoke screens are used. typically, it is employed to conceal military movement. smoke screens are a type of colloidal system in which titanium oxide particles are spread throughout the atmosphere.

10)formation of delta:

the term "delta" refers to the substantial sand and clay deposits that form at the mouth of any river that empties into the sea. the creation of a delta is a very fascinating natural process in which positively charged ions from the salt in the sea neutralize the negatively charged colloidal particles of the river, causing them to congeal. The negatively charged colloidal sand and clay particles in the river water are exactly as expected. the saline seawater, on the other hand, has a lot of positive ions in it. the colloidal clay particles in river water coagulate and deposit at the spot when it comes into touch with sea water because the positively charged ions in the sea water balance out the negatively charged ions in the river water.

11)***blue color of the sky:***

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12)***preparation of nano-materials:***

reverse micelles are utilized to create nanomaterials that are catalysts.

13)metallurgical operations:

the ore is treated in a pine oil emulsion as part of the froth flotation process used in the metallurgy of sulphide ores. The ore is treated in a pine oil emulsion as part of the froth flotation process used in the metallurgy of sulphide ores.

14)non-drip or thixotropic paints:

colloidal dispersions of solid pigments in a liquid medium make up all paints. long-chain polymers are also present in contemporary thixotropic or non-drip paints. the coils on the molecules' chains catch a lot of the dispersion medium when they are at rest. the paint is therefore a semisolid gel structure. the coiled molecules straighten when shearing stress is applied, and the trapped medium is freed as a result. the liquid paint transforms back into the semisolid state as soon as the brush is taken away. as a result, the paint is "non-drip."

conclusion:

the creation of colloidal dispersion improves a drug's solubility and speeds up the pace of dissolution. conclusion: colloidal dispersion is safe, they enhance pharmacological action, and they can be designed as controlled or sustained release for a superior biopharmaceutical approach. the principle of colloidal dispersions is used in a variety of sectors, including the food and pharmaceutical industries as well as in hospitals and day-to-day living.

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