

## 1: NFNF : Physical Pharmacy Lab Report: Part 3 : Adsorption from Solution

*The phenomenon of adsorption from solution has important implications for other phenomena that arise from the relationship between adsorption and the free energy of surfaces. Adsorption from solution measurements can be of value in discussing wettability and liquid-liquid displacement problems.*

How do you determine experimentally that equilibrium has been reached after shaking for two hours? After being shaken for two hours, the solutions were titrated by using starch solution as indicator. By referring to the flask labelled 1 to 6, compared the volume of Sodium thiosulphate,  $\text{Na}_2\text{S}_2\text{O}_3$  used with the flask labelled 7 to 6. The solution will change colour from dark blue to colourless. **DISCUSSION** Adsorption is the sticking of molecules from the gas or liquid phase onto the surface of a solid and it is different from absorption which is the filling of pores in a solid. A molecule that undergoes adsorption is referred to as the adsorbate, and the solid is the adsorbent. In the case of adsorption, the process is defined as physisorption if the adsorbate is held by weak, van der Waals type of forces on the surface. If bond formation between the adsorbate and the adsorbent is involved chemical bond, the process is commonly known as chemisorption. Similar to surface tension, adsorption is a consequence of surface energy. In a bulk material, all the bonding requirements by the ionic, covalent, or metallic of the constituent atoms of the material are filled by other atoms in the material. However, atoms on the surface of the adsorbent are not wholly surrounded by other adsorbent atoms and therefore can attract adsorbates. Adsorbents are used usually in the form of spherical pellets, rods, moldings, or monoliths. They must have high abrasion resistance, high thermal stability and small pore diameters, which results in higher exposed surface area and hence high surface capacity for adsorption. The adsorbents must also have a distinct pore structure that enables fast transport of the gaseous vapors. The most common industrial adsorbents are activated carbon, silica gel, and alumina, because they present enormous surface areas per unit weight. The amount of a substance that can be adsorbed onto activated charcoal depends on nature of adsorbate and adsorbent, the surface area of adsorbent, activation of adsorbent and experimental conditions such as temperature. Adsorption process is usually studied through graphs known as adsorption isotherm. That is the amount of adsorbate on the adsorbent as a function of its pressure or concentration at constant temperature. Example of isotherm is Langmuir equation and it is most common isotherm equation to use due to its simplicity and its ability to fit a variety of adsorption data. In this experiment, Langmuir equation is used to estimate the surface area of activated charcoal sample. Langmuir derived an equation which explained the relationship between the number of active sites of the surface undergoing adsorption and pressure. This equation is called Langmuir isotherm equation. The inverse of the slope is  $N_m$ , and this represents the moles adsorbed at monolayer coverage.  $N_m$  can be used to determine the specific surface area of a solid. The basic limitation of Langmuir adsorption equation is that it is valid at low pressure only. The actual concentration in solution A X and concentration of iodine in solution A at equilibrium was recorded and amount of iodine adsorb N was calculated from the data that was collected. Graph amount of iodine adsorb N versus balance concentration of solution C at equilibrium is not linear graph and shows that the number of iodine adsorb gradually increase in the solution. This is because the greater the solubility, the stronger are the solute-solvent bonds and hence the smaller the extent of the adsorption of iodine onto the activated charcoal. This shows that the Langmuir equation is followed. The possible errors that occur while conducting this experiment is the amount of sodium thiosulphate titrated recorded are inaccurate because the position of eye is not perpendicular to the solution so it will overall changes result of the experiment. Other than that, that amount of charcoal added is more than needed and not distributed equally over the solution. This cause the solution not achieved equilibrium. Next, the charcoal maybe included in supernatant that will affect the amount of sodium thiosulphate needed to change colour from dark blue to colourless. **Conclusion** From this experiment, the adsorption of iodine solution in charcoal follows the Langmuir theory of adsorption isotherm. The result shows that the adsorption decrease as the concentration of the iodine solution decrease. From the experimental result, the surface area of charcoal is Sinko, Lippincott Williams and Wilkins. Alexander T Florence and David Attwood. Physiocochemical Principles of Pharmacy page

## 2: FF lab report: PRACTICAL 3: ADSORPTION FROM SOLUTION

*Summary. Adsorption From Solution discusses the significance of adsorption behavior in thermodynamic terms, with emphasis on the interplay between enthalpic and entropic contributions to the free energy.*

Received Sep 8; Accepted Dec This article has been cited by other articles in PMC. The results indicated that the maximum adsorption capacity of Ni II reached The represented adsorption kinetics model exhibited good agreement between the experimental data and the pseudo-second-order kinetic model. The Langmuir isotherm equation best fit the experimental data. The satisfactory desorption capacity of Introduction Water contamination caused by heavy-metal ions generated from alloys, pigments, electroplating, mining, metallurgical activities, nuclear power plant operations, aerospace industries, electrical contacts, printing, and the manufacture of paper, rubber, plastics, and batteries [ 1 , 2 ] is a global problem receiving worldwide attention. The extended persistence of water contamination in biological systems and the tendency to bioaccumulate while moving up the food chain is a serious threat to human health, living resources, and ecological systems [ 3 , 4 ]. Nickel is a non-biodegradable toxic metal ion present in wastewater, and the presence of Ni II ions in drinking water in concentrations that exceed the permissible limit of 0. Therefore, the treatment of industrial effluents rich in Ni II before discharge is necessary. Increased awareness of heavy metal toxicity has led to a dramatic increase in research on various technologies to clean targeted water environments. Different methods, such as ion exchange, reduction, flocculation, reverse osmosis, membrane filtration, and precipitation, have been investigated for the removal of Ni II ions from aqueous solutions; however, most of these methods are expensive or generate harmful waste products [ 10 – 14 ]. Adsorption is an effective technique with many advantages, including highly efficient extraction of metals, even from dilute solutions; minimization of secondary wastes; and cost-effectiveness. Because of economic considerations, natural polymeric materials [ 15 ] are a promising alternative as adsorbents for wastewater treatment. Lignocellulose LNC is an ideal natural adsorbent for the removal of heavy-metal ions because of its specific structural characteristics [ 16 ]. LNC, which is a renewable polymer, is widely distributed in plants and is primarily composed of cellulose, hemicellulose, and lignin [ 17 ]. Moreover, a variety of reactive functional groups FGs , including phenolic, hydroxyl, carboxyl, and other FGs, exist in its three-dimensional structure and act as active sites for the adsorption of heavy metal ions [ 18 ]. However, because of its polydispersity and amorphous structure, LNC is not suitable for industrial applications. Recently, clays have been considered one of the most appropriate and inexpensive adsorbents for the removal of heavy metal ions from wastewater. Therefore, to improve the adsorption capacity of heavy metal ions on the MMT surface, the chemical modification of MMT was explored in this study. Different kinetic models were analyzed using pseudo-first-order and pseudo-second-order models. The Langmuir and Freundlich models are commonly used to describe adsorption equilibrium data and were applied to the experimental results. All other chemicals and reagents used in the study were of analytical grade and used without further purification. All solutions were prepared using deionized water. Fresh diluted solutions were used for each experiment. A suspension of MMT 1. All samples were ground and sieved to a mesh particle size and were subsequently stored in an airtight plastic container until used for the specific experiments. The suspension was stirred at a uniform speed of rpm in a thermostatic shaker SHA-C. Throughout the course of the experiments, the pH of each Ni II solution was adjusted to a constant value by periodic shaking after the addition of 0. When adsorption equilibrium was reached, the mixtures were centrifuged at rpm for 5 min. Then, the Ni II concentration of the upper fluid was determined by the dimethylglyoxime method [ 21 ]. The adsorption experiments were conducted by varying the initial Ni II concentrations, pH values, adsorption temperatures, and adsorption times. Taking into account the experimental errors and based on the average values, three independent replicates confirmed that the results of the Ni II removal experiments were reproducible under the same conditions.

## 3: Rx's UKM: Practical 1: Adsorption From Solution

*Abstract: The purpose of this paper is to suggest an interpretation of the experimental data to make the determination of the surface area of activated charcoal by Langmuir adsorption isotherm more meaningful for the student.*

The attachment or adsorption bonds can be strong and weak, depending on the nature of forces between adsorbent solid surface and adsorbate gas or dissolved solutes. There are two types of adsorption. There are chemical adsorption and Physical adsorption. Chemical adsorption or chemisorption is when adsorption involves only chemical bonds between adsorbent and adsorbate. It acquires activation energy, can be very strong and not readily reversible. It generally produces adsorption of a layer of adsorbate monolayer adsorption Physical adsorption is also known as van der Waals adsorption. It happened when the adsorbate is bound to the surface through the weak van der Waals forces. It is a non - specific reaction which can be occurred at any condition and reversible, either by increasing the temperature or reducing the pressure of the gas or concentration of the solute. Physical adsorption can produce adsorption of more than one layer of adsorbate multilayer adsorption. It is possible that chemical adsorption can be followed by physical adsorption on subsequent layers. Adsorption isotherm is study of the relationship between the degree of adsorption and the partial pressure or concentration.. In some cases, the degree of adsorption at a specified temperature depends on the partial pressure of the gas or on the concentration of the adsorbate for adsorption from solution. The studies of types of isotherm and changes of isotherm with temperature can provide useful information on the characteristics of solid and the reactions involved when adsorption occurs. Basically, physical adsorption is far more common than chemisorption In this experiment, we use the adsorption from solution to determine the surface area of activated charcoal. There are several factors will influence the extent of adsorption from solution and is summarized in the table below. Factors affecting adsorption Effect on adsorption Solute concentration Increased solute concentration will increase the amount of adsorption occurring at equilibrium until a limiting value is reached. Temperature Process is usually exothermic, therefore, an increase in temperature will decrease adsorption pH pH influences the rate of ionization of the solute, hence, the effect is dependent on the species that is more strongly adsorbed. Surface area of adsorbent An increase in surface area will increase the extent of adsorption. Determination of Surface Area of Activated Charcoal via Adsorption from Solution It is important to determine the surface area of powder drug because it is one of the factors that govern the rate of dissolution and bioavailability of drugs that are absorbed through the gastrointestinal tract. Adsorption measurements is used to determine the surface area of a solid. For the rough surfaces and pores solid , the actual surface area can be large when compared to the geometric apparent surface area. In the method of B. T Brunauer, Emmett, and Teller , adsorption of gas was used to measure the surface area. In this experiment, adsorption of iodine from solution is studied and Langmuir equation is used to estimate the surface area of activated charcoal sample. Procedure 12 conical flasks labelled is filled with 50ml mixture of iodine solutions A and B as stated in table 1. Flask Volume of solution A ml Volume of solution B ml 1 and 7.

## 4: Physical Pharmacy Lab Report: Practical 3: Adsorption from solution

*Adsorption is a process where free moving molecules of a gaseous or solutes of a solution come close and attach themselves onto the surface of the solid. The attachment or adsorption bonds can be strong or weak, depending on the nature of forces between adsorbent (solid surface) and adsorbate (gas or dissolved solutes).*

Characteristics and general requirements[ edit ] Activated carbon is used as an adsorbent Adsorbents are used usually in the form of spherical pellets, rods, moldings, or monoliths with a hydrodynamic radius between 0. They must have high abrasion resistance, high thermal stability and small pore diameters, which results in higher exposed surface area and hence high capacity for adsorption. The adsorbents must also have a distinct pore structure that enables fast transport of the gaseous vapors. Most industrial adsorbents fall into one of three classes: Oxygen-containing compounds are typically hydrophilic and polar, including materials such as silica gel and zeolites. Carbon-based compounds are typically hydrophobic and non-polar, including materials such as activated carbon and graphite. Polymer-based compounds are polar or non-polar functional groups in a porous polymer matrix. It is prepared by the reaction between sodium silicate and acetic acid, which is followed by a series of after-treatment processes such as aging, pickling, etc. These after-treatment methods results in various pore size distributions. Silica is used for drying of process air e. Zeolites[ edit ] Zeolites are natural or synthetic crystalline aluminosilicates, which have a repeating pore network and release water at high temperature. Zeolites are polar in nature. The ion exchange process is followed by drying of the crystals, which can be pelletized with a binder to form macroporous pellets. Zeolites are applied in drying of process air, CO<sub>2</sub> removal from natural gas, CO removal from reforming gas, air separation, catalytic cracking , and catalytic synthesis and reforming. Non-polar siliceous zeolites are synthesized from aluminum-free silica sources or by dealumination of aluminum-containing zeolites. This high temperature heat treatment breaks the aluminum-oxygen bonds and the aluminum atom is expelled from the zeolite framework. Activated carbon[ edit ] Activated carbon is a highly porous, amorphous solid consisting of microcrystallites with a graphite lattice, usually prepared in small pellets or a powder. It is non-polar and cheap. Activated carbon nitrogen isotherm showing a marked microporous type I behavior Activated carbon can be manufactured from carbonaceous material, including coal bituminous, subbituminous, and lignite , peat, wood, or nutshells e. The manufacturing process consists of two phases, carbonization and activation. The carbonization process includes drying and then heating to separate by-products, including tars and other hydrocarbons from the raw material, as well as to drive off any gases generated. The carbonized particles are then "activated" by exposing them to an oxidizing agent, usually steam or carbon dioxide at high temperature. This agent burns off the pore blocking structures created during the carbonization phase and so, they develop a porous, three-dimensional graphite lattice structure. The size of the pores developed during activation is a function of the time that they spend in this stage. Longer exposure times result in larger pore sizes. The most popular aqueous phase carbons are bituminous based because of their hardness, abrasion resistance, pore size distribution, and low cost, but their effectiveness needs to be tested in each application to determine the optimal product. Activated carbon is used for adsorption of organic substances and non-polar adsorbates and it is also usually used for waste gas and waste water treatment. It is the most widely used adsorbent since most of its chemical e. Its usefulness also derives from its large micropore and sometimes mesopore volume and the resulting high surface area. Carbon capture and storage[ edit ] Typical adsorbents used in carbon capture and storage are zeolites and MOFs. Because adsorbents can be regenerated by temperature or pressure swing, this step can be less energy intensive than absorption regeneration methods. Indeed, biomaterial surfaces in contact with biological media, such as blood or serum, are immediately coated by proteins. Therefore, living cells do not interact directly with the biomaterial surface, but with the adsorbed proteins layer. This protein layer mediates the interaction between biomaterials and cells, translating biomaterial physical and chemical properties into a "biological language". Protein adsorption is influenced by many surface properties such as surface wettability , surface chemical composition [15] and surface nanometre-scale morphology. Combining an adsorbent with a refrigerant, adsorption chillers

use heat to provide a cooling effect. This heat, in the form of hot water, may come from any number of industrial sources including waste heat from industrial processes, prime heat from solar thermal installations or from the exhaust or water jacket heat of a piston engine or turbine. Although there are similarities between adsorption chillers and absorption refrigeration, the former is based on the interaction between gases and solids. The adsorption chamber of the chiller is filled with a solid material for example zeolite, silica gel, alumina, active carbon or certain types of metal salts, which in its neutral state has adsorbed the refrigerant. When heated, the solid desorbs releases refrigerant vapour, which subsequently is cooled and liquefied. This liquid refrigerant then provides a cooling effect at the evaporator from its enthalpy of vaporization. In the final stage the refrigerant vapour is re adsorbed into the solid.

Portal site mediated adsorption[ edit ] Portal site mediated adsorption is a model for site-selective activated gas adsorption in metallic catalytic systems that contain a variety of different adsorption sites. In such systems, low-coordination "edge and corner" defect-like sites can exhibit significantly lower adsorption enthalpies than high-coordination basal plane sites. As a result, these sites can serve as "portals" for very rapid adsorption to the rest of the surface. The phenomenon relies on the common "spillover" effect described below, where certain adsorbed species exhibit high mobility on some surfaces. The model explains seemingly inconsistent observations of gas adsorption thermodynamics and kinetics in catalytic systems where surfaces can exist in a range of coordination structures, and it has been successfully applied to bimetallic catalytic systems where synergistic activity is observed. In contrast to pure spillover, portal site adsorption refers to surface diffusion to adjacent adsorption sites, not to non-adsorptive support surfaces. The model appears to have been first proposed for carbon monoxide on silica-supported platinum by Brandt et al. The same group applied the model to CO hydrogenation Fischer-Tropsch synthesis. The presence of the metal serves as a lower-energy pathway for gaseous species to first adsorb to the metal and then diffuse on the support surface. This is possible because the adsorbed species attains a lower energy state once it has adsorbed to the metal, thus lowering the activation barrier between the gas phase species and the support-adsorbed species. Hydrogen spillover is the most common example of an adsorptive spillover. In the case of hydrogen, adsorption is most often accompanied with dissociation of molecular hydrogen H<sub>2</sub> to atomic hydrogen H, followed by spillover of the hydrogen atoms present. The spillover effect has been used to explain many observations in heterogeneous catalysis and adsorption. Polymers may also be adsorbed to surfaces through polyelectrolyte adsorption.

Adsorption in viruses[ edit ] Adsorption is the first step in the viral life cycle. The next steps are penetration, uncoating, synthesis transcription if needed, and translation, and release. The virus replication cycle, in this respect, is similar for all types of viruses. In popular culture[ edit ] The game of Tetris is a puzzle game in which blocks of 4 are adsorbed onto a surface during game play. Scientists have used Tetris blocks "as a proxy for molecules with a complex shape" and their "adsorption on a flat surface" for studying the thermodynamics of nanoparticles.

### 5: PHYSICAL PHARMACY: PRACTICAL 3 : Adsorption from solution

*Adsorption from solution ADSORPTION The removal of molybdates and tungstates from aqueous solution by organo-smectites. This paper presents the results obtained when studying the removal of molybdate and tungstate anions from aqueous using organically modified montmorillonite.*

To determine surface area of activated charcoal via adsorption from solution. Adsorption is the adhesion of atoms, ions, or molecules from a gas, liquid, or dissolved solid to a surface. This process creates a film of the adsorbate on the surface of the adsorbent. This process differs from absorption, in which a fluid the adsorbate permeates or is dissolved by a liquid or solid the adsorbent. Adsorption is a surface-based process while absorption involves the whole volume of the material. The term sorption encompasses both processes, while desorption is the reverse of it. Adsorption is a surface phenomenon. This type of adsorption is known as physical adsorption or van der Waals adsorption. This process is non-specific and can occur at any condition. This type of adsorption is reversible, by increasing temperature or reducing pressure of the gas or concentration of the solute. Depending upon the nature of forces existing between adsorbate molecules and adsorbent, the adsorption can be classified into two types: In physical adsorption the force of attraction between the adsorbate and adsorbent are very weak, therefore this type of adsorption can be easily reversed by heating or by decreasing the pressure. If the force of attraction existing between adsorbate and adsorbent are almost same strength as chemical bonds, the adsorption is called chemical adsorption. It is also known as Langmuir adsorption. In chemisorption the force of attraction is very strong, therefore adsorption cannot be easily reversed. Several factors will influence the extent of adsorption from solution: Nature of adsorbate and adsorbent 2. The surface area of adsorbent. Determination of the surface area of powder drug, which is related to its particle size, is important in the field of pharmacy. Adsorption measurement can be used to determine the surface area of a solid. With rough surfaces and pores, the actual surface area can be large when compared to the geometric apparent surface area. In the method of B. T Brunauer, Emmet and Teller , adsorption of gas was used to measure the surface area. In this experiment, adsorption of iodine from solution is studied and Langmuir equation is used to estimate the surface area of activated charcoal sample. In this experiment, 12 conical flasks are prepared and labeled 1 to These conical flasks are filled with 50ml mixtures of iodine solutions A and B as stated in the Table 1 by using burettes or measuring cylinders. Actual concentration of iodine in solution A X For flasks From dark blue solution Set 2: Concentration of iodine in solution A at equilibrium C For flasks Each conical flask was labeled appropriately. Calculate N for iodine in each flask.

## 6: Adsorption from solution

*Adsorption From Solution discusses the significance of adsorption behavior in thermodynamic terms, with emphasis on the interplay between enthalpic and entropic contributions to the free energy.*

Adsorption from solution Application of chitosan in removal of molybdate ions from contaminated water and groundwater Water pollution by heavy metals represents a serious problem around the world. Among various treatment techniques for water remediation, adsorption is an effective and versatile method due to the low cost, effectiveness and simplicity. Chitosan is a cationic polysaccharide with an excellent adsorption capacity of heavy metal ions. Participation of hydroxyl groups in the adsorption of molybdate anions was confirmed by FT-IR analysis. Continuous adsorption data were best fitted by Modified Dose- Response model. Scale-up of continuous processes was achieved applying bed depth service time BDST model. Application of chitosan in molybdate removal from real groundwater samples suggest that this polysaccharide is a good option to be used for household purposes. We found that akaganeite can incorporate up to Simultaneously, the crystal structure unit cell parameters a, b and c decrease, while beta increases with increasing Mo content. Surprisingly, dissolution of akaganeite by *Shewanella loihica* PV-4 showed higher dissolution rates of Mo-bearing akaganeite compared to Mo-free akaganeite. Furthermore, X-ray absorption spectra collected at the Mo L3-edge show a peak-splitting of the white line with a splitting gap of 2. Sorption of molybdenum VI ions on natural mineral sorbents The sorption of Mo VI ions on natural sorbents zeolite tuffs and clinker is investigated. It is estimated that zeolite tuffs sorb polymer forms of Mo VI ions in acidic media, while the monomer form of molybdate ion is sorbed in basic media. It is concluded that the rate of sorption of molybdenum VI ions on zeolite tuffs is regulated by an intradiffusional mechanism. Values of the activation energy indicate that the adsorption of molybdenum VI ions on zeolite tuffs is governed by a physical mechanism. The excretion of crystalline phase probably calcium molybdate on surfaces of zeolite tuff is estimated via scanning electron microscopy. In batch experiments, the influence of pH, reaction time, the initial concentration of Mo and W, and the influence of the amount and type of surfactant was investigated. The modification of smectite with leads to the formation of an organo-mineral complex characterized by a positively -charged surface and a high sorption capacity in the removal of Mo VI and W VI. The pH effect determining the possibility of Mo and W removal from the aqueous solution. With an increasing amount of surfactant used in modification process, the sorption efficiency increases. Kinetic studies indicated that maximum sorption capacity is achieved faster in the case of Mo than of W, and that the main sorption mechanisms are chemisorption and ion exchange. C Elsevier B. Molybdate adsorption High efficient removal of molybdenum from water by Fe<sub>2</sub> SO<sub>4</sub> 3: Effects of pH and affecting factors in the presence of co-existing background constituents Comparatively investigated the different effects of Fe<sub>2</sub> SO<sub>4</sub> 3 coagulation-filtration and FeCl<sub>3</sub> coagulation-filtration on the removal of Mo VI. And the influence of calcium, sulfate, silicate, phosphate and humic acid HA were also studied. The following conclusions can be obtained: Firstly the influence of co-existing background anions on the content of Fe intercepted from water intercepted Fe. Secondly the competition of co-existing anions with Mo VI for adsorption sites. Thirdly the influence of co-existing background anions on the Zeta potential of the iron flocs. Effects of pH and affecting factors in the presence of co-existing background constituents, Journal of Hazardous Materials, , , Simultaneous biosorption of selenium, arsenic and molybdenum with modified algal-based biochars Ash disposal waters from coal-fired power stations present a challenging water treatment scenario as they contain high concentrations of the oxyanions Se, As and Mo which are difficult to remove through conventional techniques. In an innovative process, macroalgae can be treated with Fe and processed through slow pyrolysis into Fe-biochar which has a high affinity for oxyanions. However, the effect of production conditions on the efficacy of Fe-biochar is poorly understood. We produced Fe-biochar from two algal sources; "Gracilaria waste" organic remnants after agar is extracted from cultivated Gracilaria and the freshwater macroalgae Oedogonium. The optimized Fe-biochar for each biomass was produced by treatment with a The Fe-biochar produced in this way had higher a biosorption capacity for As and Mo Regardless, the optimal Fe-biochars from both biomass sources

were able to effectively treat Se, As and Mo simultaneously in an ash disposal effluent from a power station. The production of Fe-biochar from macroalgae is a promising technique for treatment of complex effluents containing oxyanions. Batch experiments addressing Mo adsorption onto goethite were conducted with phosphate, sulfate, silicate, and tungstate as competing anions in order to produce competitive two anions adsorption envelopes, as well as competitive two anions adsorption isotherms. Tungstate and phosphate appear to be the strongest competitors of Mo for the adsorption sites of goethite, whereas little competitive effects were observed in the case of silicate and sulfate. Mo adsorption isotherm from a phosphate solution was similar to the one from a tungstate solution. The model suggests that Mo and W are retained mainly by the formation of monodentate complexes on the goethite surface. Our results indicate that surface complexation modeling may have applications in predicting competitive adsorption in more complex systems containing multiple competing ions. Adsorption of molybdate by synthetic hematite under alkaline conditions: This study explored the ability of synthetic hematite to retain one such contaminant, molybdate, on its surfaces under highly alkaline pH ca10 conditions. Raman spectra show that the hematite efficiently adsorbs molybdate and retains it on its surfaces via strong inner-sphere surface complexation. SEM images show that aged hematite particles with adsorbed molybdate are similar in size and shape to pure hematite and exhibit no significant reduction in surface area. These findings are valuable for understanding the fate of molybdenum in mine wastes and mill tailings environments where the ferrihydrite to which it is adsorbed can transform to hematite. C Elsevier Ltd. All rights reserved Das, S. Effects of aging, Applied Geochemistry, , 28, The heterogeneous isotopic anion exchange between calcium molybdate and sodium molybdate solutions have been studied by using  $^{99}\text{Mo}$  as tracer. Molybdate,  $[\text{MoO}_4]^{2-}$ , was adsorbed reversibly by pyrite forming labile bidentate, mononuclear surface complexes. Because of the high affinity of  $[\text{MoS}_4]^{2-}$  for  $\text{FeS}_2$  and its resistance to desorption thiomolybdate species may be the reactive Mo constituents in reduced sediments and may control Mo enrichment in anoxic marine environments. The adsorption of molybdate  $\text{MoO}$  and tetrathiomolybdate  $\text{MoS}$  by pyrite  $\text{FeS}_2$  and goethite  $\text{FeOOH}$  has been studied in relation to molybdenum immobilization in anoxic sediments and the competitive effects of sulfate, phosphate, and silicate on the adsorption of  $\text{MoO}$  and  $\text{MoS}$  by pyrite and goethite. Suspensions of  $\text{MoS}$  or  $\text{MoO}$  and goethite or pyrite in 0. Phosphate competes with  $\text{MoO}$  and  $\text{MoS}$  for the sorption sites of pyrite and goethite Phosphate competition decreases: Silicate and sulfate have a negligible effect on the sorption of  $\text{MoO}$  and  $\text{MoS}$  That  $\text{MoS}$  is the most strongly adsorbed species by goethite and least susceptible to competition by phosphate suggests that tetrathiomolybdate species may be an ultimate reservoir and may control molybdenum enrichment in the sediments. Effect of pH and competitive anions, Chemosphere, , 62, Molybdenum molybdate adsorption to iron oxyhydroxides - isotope fractionation Note: Molybdenum was applied as an aqueous solution of sodium molybdate,  $\text{Na}_2\text{MoO}_4$ . The species adsorbed is the molybdate ion or a protonated species. Molybdenum isotopes have great potential as a paleoredox indicator, but this potential is currently restricted by an incomplete understanding of isotope fractionations occurring during key biogeochemical processes. Iron oxyhydroxides can readily adsorb molybdate, highlighting the potential importance of this removal pathway for the global molybdenum cycle. Furthermore, adsorption of molybdate to iron oxyhydroxides is associated with preferential uptake of the lighter molybdenum isotopes. The different fractionation factors determined for different iron oxyhydroxides suggests that these minerals exert a major control on observed natural molybdenum isotope compositions during sediment deposition beneath suboxic through to anoxic but non-sulfidic bottom waters. Molybdenum isotopes can provide important information on the spatial extent of different paleoredox conditions, providing they are used in combination with other techniques for evaluating the local redox environment and the mineralogy of the depositing sediments. The removal of sulfate and molybdate anions among other anions from mining liquid effluents is attracting much interest because of environmental legislation and the need for water recycling and reuse. Adsorption of sulfate and molybdate ions on chitin-based materials was investigated. The regeneration of the adsorbent material was possible through the anions desorption in alkaline medium. All experiments were carried out by dynamic column sorption. Sorption of tungstate and molybdate anions was successful. The sorption capacity decreased with increasing concentration of accompanying anions chlorides, sulphates and with increasing pH 3. Sorption of

## ADSORPTION FROM SOLUTION pdf

vanadate anion was possible but the sorption capacity was very low. Chemically modified seaweed This paper provides some data on interaction of molybdate with functional groups of an adsorbent and compares molybdate adsorption with tungstate adsorption. Seaweed is a heterogeneous mixture of polysaccharides which may sorb metal ions. Oxoanions of tungsten, molybdenum, vanadium, germanium and antimony were sorbed by seaweeds, *Ascophyllum nodosum*, modified by crosslinking with 1 hexamethylenediamine NS-1 , which partially removed carboxylate giving a sorbent with OH, NH<sub>2</sub> and residual CO<sub>2</sub><sup>-</sup> and 2 with epichlorhydrin DS-1 , giving a matrix more accessible to polyoxoanions. Breakthrough concentrations were determined in dynamic column sorption mode. Tungstate, molybdate, and vanadate were most adsorbed. Data for molybdate and tungstate sorption at pH 3.

### 7: Adsorption - Wikipedia

*Adsorption of a solution is done by separating solids and solutions by estimating the amount of adsorbate in contact to the solid or if there is a loss in concentration of adsorbate from a solution. This is useful in the treatment of severe over dosage of drugs.*

### 8: eutecticfive: EXPERIMENT 3: ADSORPTION FROM SOLUTION

*Adsorption is the adhesion of atoms, ions or molecules from a gas, liquid or dissolved solid to a surface. This process creates a film of the adsorbate on the surface of the adsorbent.*

### 9: Adsorption From Solutions Assignment Help - Adsorption From Solutions Homework Help Online

*1 EXPERIMENT 5 ADSORPTION FROM SOLUTION Introduction The term adsorption is used to describe the fact that there is a greater concentration of the.*

*A Quaker experiment in government Mann and manners at the court of Florence, 1740-1786. Protective relaying principles and applications 3rd edition Speeches delivered during the visit to the Algerian Democratic and Peoples Republic. The Never Ending Pigeon Saga V. 6. Thermal destruction monograph principal authors, Francis W. Holm . [et al.] Fitness levels of children in North Carolina Imitation of live and televised models by children one to three years of age Critical analysis essay outline Ladino Rabbinic Literature And Ottoman Sephardic Culture (Jewish Literature and Culture) Child trafficking Bonding with baby. Battling Tradition Suudi relations with eastern Arabia and Uman, 1800-1870 Dreams and secrets DiAnn Mills Yang-Mills fields and extension theory Aptitude books in format 5.6 OO System Testing Caribbean Artists Movement, 1966-1972 The seven states of California Payroll activities for a service based business Modern Mexican art Bank officers handbook of commercial banking law V. 1. From antiquity to the Tang dynasty The dwarfing of Europe Final report of the United States De Soto Expedition Commission Objective physics for iit-jee Talley and o connor clinical examination 7th edition Seminar on High Speed Road Corridors, Vigyan Bhawan, New Delhi, 23-24 September, 2005 Miracle Eyesight Method Think and grow rich file Active Assessment for Literacy Ideal efficiency of propellers Kashmir and Its Inhabitants Grimmelshausens laughter, by H. Speier. V. 3-4. The second administration of Thomas Jefferson, 1805-1809. Activities : manipulatives The university teaching of social sciences: statistics Saxon course 2 solutions manual Nutrition and metabolism*