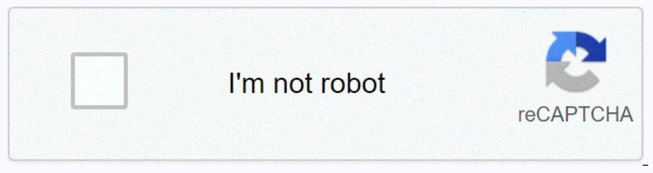

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Physical and chemical properties of ocean water ppt

1 PROPERTIES OF SEAWATER 2 WHY IS WATER IMPORTANT Life started in water. The earth is about 72% covered with water. Living organisms are >70% water. All living organisms spend their early life stages in water or moist environments. 3 EARTH'S WATER Oceans 97.2 % Ice Caps and Glaciers 2.15 %Atmosphere % Rivers and Lakes % Inland Seas % Groundwater % 4 EARTH'S WATER 5 EARTH'S WATER 6 WATER PHASES 7 FRESH WATER DENSITY 8 CHEM BASICS 9 WATER'S CHEMISTRY 10 WATER AS AN ACID 11 DISSOLVING WATER DISSOLVING INTERACTIVE PROPERTIES OF WATER ANIMATION 12 HOW DOES IT GET THERE 13 THE WATER CYCLE 14 HOW DOES WATER CHANGE Heat Capacity: heat needed to change the temperature of a substance Water has higher heat capacity than: All solids All liquids, except liquid ammonia Latent Heat: heat needed to phase change Water has the highest of all substances FUSION: Freezing, Melting VAPORIZATION: Evaporating, Condensing 15 SALINITY Salinity = total amount of solid material dissolved in waterCan be determined by measuring water conductivity Typically expressed in parts per thousand (‰) 16 salinity Average seawater salinity = 35‰Main constituents of ocean salinity: Chloride (Cl–) Sodium (Na+) Sulfate (SO42–) Magnesium (Mg2+) 17 Salinity variations Location/type Salinity Normal open ocean 33-38‰Baltic Sea 10‰ (brackish) Red Sea 42‰ (hypersaline) Great Salt Lake 280‰ Dead Sea 330‰ Tap water 0.8‰ or less Premium bottled water 0.3‰ 18 salinity What mass of dissolved salts would be present in a sample of seawater that has a salinity of 30 ‰? What percentage of dissolved salts would be present in water that has a salinity of 40‰? A 1000g sample of ocean water contains 35g of dissolved solids. Magnesium makes up 7.7% of the 35g of dissolved solids. How many grams of magnesium are in the 1000g sample of ocean water? 19 SALINITY practice work 20 Ocean buffering Ocean pH = 8.1 (slightly basic)Buffering protects the ocean from experiencing large pH changes 21 Seawater salinity Processes that decrease seawater salinity:Precipitation Runoff Icebergs melting Sea ice melting Processes that increase seawater salinity: Sea ice forming Evaporation 22 Hydrologic cycle 23 Surface salinity variationPattern of surface salinity: Lowest in high latitudes Highest in the tropics Dips at the Equator Surface processes help explain pattern 24 Global surface salinity 25 Salinity and depth Curves for high and low latitudes begin at different surface salinities Halocline = layer of rapidly changing salinity At depth, salinity is uniform 26 Seawater density Factors affecting seawater density:Temperature ↑, Density ↓ (inverse relationship) Salinity ↑, Density ↑ Pressure ↑, Density ↑ Temperature has the greatest influence on surface seawater density 27 Sea surface temperatures 28 Deep water temperatures 29 D and t with depth 30 Changing seasonal thermoclines at mid latitudes 31 desalination 32 Reverse osmosis 33 desalination 1. MHRD NME-ICT Topic of the lesson Properties of Seawater Properties of SeawaterProperties of Seawater By Prof.A. Balasubramanian Centre for Advanced Studies in Earth Science University of Mysore, India 2. MHRD NME-ICT Table of Contents 3. MHRD NME-ICT The chemical composition of seawater is an essential topic in oceanography. After attending this module, the user would be able to know about the properties of seawater, their variations and distribution in the oceans. The role of seawater in controlling the marine ecosystems and life are also highlighted in this module. Objectives 4. MHRD NME-ICT All water existing at or near the surface of the Earth belongs to the hydrosphere. It includes atmospheric water vapor, groundwater, lakes, rivers, polar icecaps and the oceans. The waters of the oceans and seas cover more than 70 percent of the Earth's surface. The water that is most often found in nature is the seawater. It is about 98%, existing on the globe as seas and oceans. The rest is distributed as ice, water vapor, and fresh water on land. Introduction (…Contd) 5. MHRD NME-ICT Oceanic waters play a very important role in controlling the global weather and climate, interactions between atmosphere and the hydrosphere and maintaining water balance of the globe. Oceans also provide enormous living and non-living resources for many life forms to survive. Seawater has a very unique chemistry, physics and biology. (…Contd) Introduction 6. MHRD NME-ICT Seawater is one of the most fascinating and plentiful substances on the planet. The basic properties of Seawater and their distribution, the interchange of properties between sea and atmosphere or land, the transmission of energy within the sea, and the geochemical laws which are governing the composition of seawater and marine sediments, are the fundamental aspects studied in the subject of oceanography. Introduction 7. MHRD NME-ICT The key roles of the oceans are: a) They absorb and reflect sun light b) They store the heat c) They transport the stored heat d) They cause major changes in the climate system e) They are the main source of atmospheric water vapour f) They exchange gases (e.g. CO_2) with the atmosphere. Key Roles of the OceansKey Roles of the Oceans 8. MHRD NME-ICT To know the role of seawater in the earth's hydrosphere, the following aspects are to be understood first: 1. Physical properties of seawater 2. Chemical composition of seawater 3. Biological Conditions of seawater 4. Temperature distribution in oceans 5. Salinity and density of oceans. Seawater in hydrosphereSeawater in hydrosphere (…Contd) 9. MHRD NME-ICT Seas and oceans are very huge bodies of saline waters. Their distribution and dynamics are very influential in several ways. Understanding the properties of seawater is inevitable in oceanographic studies. Seawater in hydrosphereSeawater in hydrosphere 10. MHRD NME-ICT The waters of the seas and oceans has formed over millions of years. Most people do not realize the complex nature of seawater. In fact seawater cannot be duplicated in any lab anywhere in the world. Seawater has its own physical, chemical and biological properties. Physical Properties of SeawaterPhysical Properties of Seawater (…Contd) 11. MHRD NME-ICT Due to its huge volume and thickness, it has certain unique characteristics in the distribution of temperature, pressure and density. Most of these properties vary horizontally and vertically. Physical properties also act as limiting factors in marine ecosystems. Physical Properties of SeawaterPhysical Properties of Seawater 12. MHRD NME-ICT Water, in general, is a good solvent. Seawater is an effective solvent. Seawater is also at the receiving end to dissolve all the sediments derived from land. Rivers carry much of the dissolved organic and inorganic substances towards the sea. These loads increase the salts of the oceans every year. It has many conservative and non-conservative properties. An Efficient SolventAn Efficient Solvent 13. MHRD NME-ICT Seawater has several unique properties like high heat capacity latent heat of fusion (LHF) latent heat of vaporization latent heat of melting thermal expansion density viscosity and turbidity. High Heat CapacityHigh Heat Capacity 14. MHRD NME-ICT Water has the capacity to store heat, conduct heat and release heat. The heat capacity of seawater is the highest of all solids and liquids except liquid ammonia. The heat transfer in oceanic currents is large. The latent heat of fusion (LHF) is also the highest in seawater except ammonia. Hence, it acts as a thermostat at freezing point owing to uptake or release of latent heat. High LHFHigh LHF 15. MHRD NME-ICT Latent Heat of EvaporationLatent Heat of Evaporation The latent heat of evaporation is yet another property, which is also the highest in seawater than other substances. It is important in heat and water transfers to the atmosphere. Thermal expansion is another important property of seawater. The temperature of maximum density decreases with increasing salinity. For pure water it is at 4 deg. C. 16. MHRD NME-ICT Seawater is characterized by its surface tension. It is the highest among all liquids. Seawater is colorless in small volumes. Due to the presence of organic life and sediment loads near the coasts, it may look greenish blue or turbid in some places. High Surface TensionHigh Surface Tension (…Contd) 17. MHRD NME-ICT Blue is the longest wavelength of the colors of the spectrum. Since it is the last one to be absorbed by the ocean, it is the most dominant color reflected. When descending into the sea, the colors of the spectrum begin to be filtered out. The first color to disappear is red. High Surface TensionHigh Surface Tension 18. MHRD NME-ICT In addition to these, seawater also transmits sound. The speed of sound travelling in Seawater is also a special feature. It is about 1500 m per second and some low frequencies travel for long distances also. Hence, it is possible to analyze the depth of the seas and oceans using sound waves. Transmitting Sound WavesTransmitting Sound Waves 19. MHRD NME-ICT Seawater is a complex mixture of water, salts and many other organic and inorganic substances. Seawater contains more dissolved ions than all other types of water like river water, rainwater, lake water and groundwater. It contains 96.5 percent water, 2.5 percent salts, and smaller amounts of other substances, including dissolved inorganic and organic materials, particulates, and a few atmospheric gases. Chemical Composition of SeawaterChemical Composition of Seawater (…Contd) 20. MHRD NME-ICT The chemical composition and ratios of the minerals and naturally occurring elements are too complex to accurately replicate. The chemical constituents of seawater include major ions and minor trace elements. In addition, Seawater contains the suspended solids, organic substances, and dissolved gases. Chemical Composition of SeawaterChemical Composition of Seawater 21. MHRD NME-ICT Seawater chemistry shows 96 percent water and only 4 percent other elemental composition. Oxygen alone is 85.84% Hydrogen is 10.82% Chloride is 1.94% Sodium is 1.08% Magnesium is 0.12%. (…Contd) Elemental CompositionElemental Composition 22. MHRD NME-ICT Sulfur is 0.09 % Calcium is 0.04% Potassium is 0.04 % Bromine is 0.0067% Carbon is 0.0028%. Elemental CompositionElemental Composition 23. MHRD NME-ICT Because of these, seawater is dominated by six most abundant ions like chloride (Cl-), sodium (Na+), sulfate (SO2 4 -), magnesium (Mg2+), calcium (Ca2+), and potassium (K+). By weight these ions make up to about 99 percent of all sea salts. Six Abundant IonsSix Abundant Ions 24. MHRD NME-ICT When we analyse seawater, the major ion composition of seawater will be invariably showing the following composition in mg/L. Ions Concentration in seawater in mg/L Chloride (Cl-) 18980 mg/L Sodium (Na+) 10556 mg/L Sulfate (SO4 2-) 2649 mg/L Magnesium (Mg2+) 1262 mg/L Overall ChemistryOverall Chemistry (…Contd) 25. MHRD NME-ICT Calcium (Ca2+) 400 mg/L Potassium (K+) 380 mg/L Bicarbonate (HCO3 -) 140 mg/L Strontium (Sr2+) 13 mg/L Bromide (Br-) 65 mg/L Borate (BO3 3-) 26 mg/L. Overall ChemistryOverall Chemistry (…Contd) 26. MHRD NME-ICT Fluoride (F-) 1 mg/L Silicate (SiO3 2-) 1 mg/L Iodide (I-) 300 hyperhaline 60 – 80 metahaline 40 mixoeuhaline 30 polyhaline 18 mesohaline 5 oligohaline 80. MHRD NME-ICT Marine waters are those of the ocean, another term for which is euhaline seas. The salinity of euhaline seas is 30 to 35. Brackish seas or waters have salinity in the range of 0.5 to 29 and metahaline seas from 36 to 40. These waters are all regarded as thalassic because their salinity is derived from the ocean and defined as homohaline if salinity does not vary much over time (essentially constant). Types of SeasTypes of Seas 81. MHRD NME-ICT Salinity is an Ecological FactorSalinity is an Ecological Factor The ocean salinity at the surface is high and then salinity decreases until a depth of about 1,000 meters. Salinity then increases again slightly with increasing depth. The halocline is a layer of water where the salinity changes rapidly with depth. Salinity is an ecological factor of considerable importance, influencing the types of organisms that live in a body of water. (…Contd) 82. MHRD NME-ICT Salinity is an Ecological FactorSalinity is an Ecological Factor As well, salinity influences the kinds of plants that will grow either in a water body, or on land fed by water (or by a groundwater). A plant adapted to saline conditions is called a halophyte. Organisms (mostly bacteria) that can live in very salty conditions are classified as extremophiles, halophiles specifically. An organism that can withstand a wide range of salinities is euryhaline. 83. MHRD NME-ICT The degree of salinity in oceans is a driver of the world's ocean circulation, where density changes due to both salinity changes and temperature changes at the surface of the ocean produce changes in buoyancy, which cause the sinking and rising of water masses. Water CirculationWater Circulation 84. MHRD NME-ICT Changes in the salinity of the oceans are thought to contribute to global changes in carbon dioxide as more saline waters are less soluble to carbon dioxide. Salinity affects ocean organisms because the process of osmosis transports water towards a higher concentration through cell walls. Fish with a cellular salinity of 1.8% will swell in fresh water and dehydrate in salt water. (…Contd) Changes in SalinityChanges in Salinity 85. MHRD NME-ICT Saltwater fish drink water copiously while excreting excess salts through their gills. Freshwater fish do the opposite by not drinking but excreting copious amounts of urine while losing little of their body salts. Marine plant life (seaweeds) and many lower organisms have no mechanism to control osmosis, which makes them very sensitive to the salinity of the water in which they live. Changes in SalinityChanges in Salinity (…Contd) 86. MHRD NME-ICT This world map shows how the salinity of the oceans changes slightly from around 32ppt (3.2%) to 40ppt (4.0%). Low salinity is found in cold seas, particularly during the summer season when ice melts. Changes in SalinityChanges in Salinity 87. MHRD NME-ICT High salinity is found in the ocean 'deserts' in a band coinciding with the continental deserts. Lowest salinity is found in the upper reaches of the Baltic Sea (0.5%). The Dead Sea is 24% saline, containing mainly magnesium chloride $MgCl_2$. Shallow coastal areas are 2.6-3.0% saline and estuaries 0-3%. High SalinityHigh Salinity (…Contd) 88. MHRD NME-ICT The density of a water sample is a measure of the total mass in a given unit volume. The density of fresh water is 1.00 (gram/ml or kg/liter) but added salts can increase this. The saltier the water, the higher the density. When water warms, it expands and becomes less dense. High SalinityHigh Salinity 89. MHRD NME-ICT The colder the water, the denser it becomes. So it is possible that warm salty water remains on top of cold, less salty water. The density of 35ppt saline seawater at 15ºC is about 1.0255, or s (sigma)= 25.5. Another word for density is specific gravity. The deep ocean is layered with the densest water on bottom and the lightest water on top. DensityDensity (…Contd) 90. MHRD NME-ICT Circulation in the depths of the ocean is horizontal. That is, water moves along the layers with the same density. The density of ocean water is rarely measured directly. DensityDensity (…Contd) 91. MHRD NME-ICT Salinity increases the density because the dissolved salts are contained in the same volume as the water. Cold seawater is denser than warm seawater. There are several areas at the ocean surface where the surface water becomes very cold. DensityDensity (…Contd) 92. MHRD NME-ICT Density differences among different water masses allow physical oceanographers to calculate the movements of water in the oceans. Water molecules cluster more closely around positive and negative ions in solution in a process called electrostriction, which also serves to increase sea- water density. DensityDensity (…Contd) 93. MHRD NME-ICT Density of water in the ocean, reported as sigma t (σ t) is calculated from temperature, salinity and pressure by using the equation of state for seawater: σ t = (1) × 1,000.σ − DensityDensity 94. MHRD NME-ICT Properties of SeawaterProperties of Seawater At 4°C and with the salinity of 35, the density ofσ seawater is 1.02781 gram per cubic centimeter. At depth, pressure from the overlying ocean water becomes very high (pressure at 4,000 meters is about 400 atmospheres), but water is only slightly compressible, so that there is only a minor pressure effect on density. (…Contd) 95. MHRD NME-ICT At a depth of 4,000 meters, water decreases in volume only by 1.8 percent. Although the high pressure at depth has only a slight effect on the water, it has a much greater effect on easily compressible materials. Properties of SeawaterProperties of Seawater 96. MHRD NME-ICT The relationship between temperature, salinity and density is shown by the blue isopycnal (of same density) curves in this diagram. In red, green and blue the waters of the major oceans of the planet is shown for depths below -200 metre. The Pacific has most of the lightest water with densities below 26.0, whereas the Atlantic has most of the densest water between 27.5 and 28.0. Interdependent PropertiesInterdependent Properties (…Contd) 97. MHRD NME-ICT Antarctic bottom water is indeed densest for Pacific and Indian oceans but not for the Atlantic which has a lot of similarly dense water. The density of ocean water varies. It becomes more dense as it becomes colder, right down to its freezing point of -1.9 degrees C. The density of pure water is 1000 kg/m3 . Ocean water is more dense because of the salt in it. Density of ocean water at the sea surface is about 1027 kg/m3 . Interdependent PropertiesInterdependent Properties 98. MHRD NME-ICT The composition of seawater is affected by many different chemical and physical transport mechanisms. The Dissolved substances and particulates are regularly added to the oceans by rivers. The particulates may be transported by the wind to mid-ocean regions. Many chemical substances are also added to deep ocean waters by hydrothermal solutions. ConclusionConclusion (…Contd) 99. MHRD NME-ICT Seawater is a rich source of various commercially important chemical elements. Much of the world's magnesium is recovered from seawater. In certain parts of the world, sodium chloride (table salt) is still obtained by evaporating seawater. The waters of the seas and oceans have formed over millions of years. ConclusionConclusion (…Contd) 100. MHRD NME-ICT Most people do not realize the complex nature of seawater. In fact, the seawater cannot be easily duplicated in any lab in any manner in the world. The chemical composition and ratios of the minerals and naturally occurring elements of seawater are too complex to accurately replicate. ConclusionConclusion 101. MHRD NME-ICT Thank YouThank You