Chapter 1C ~ Investigating the Cause of the Fish Kill

The end is in sight!

So what do we know so far…

* Ruled out…
  * Toxic substances
  * Suspended particles
* Next thing to consider…
  * Dissolved substances

Solutions

* Review –
  * Solutions are homogeneous mixtures
  * Contain a solute and a solvent

gets dissolved

does the dissolving

Solubility

* Solubility refers to the amount of solute that can be dissolved in the solvent.

* Given in g solute/100 g of solvent at

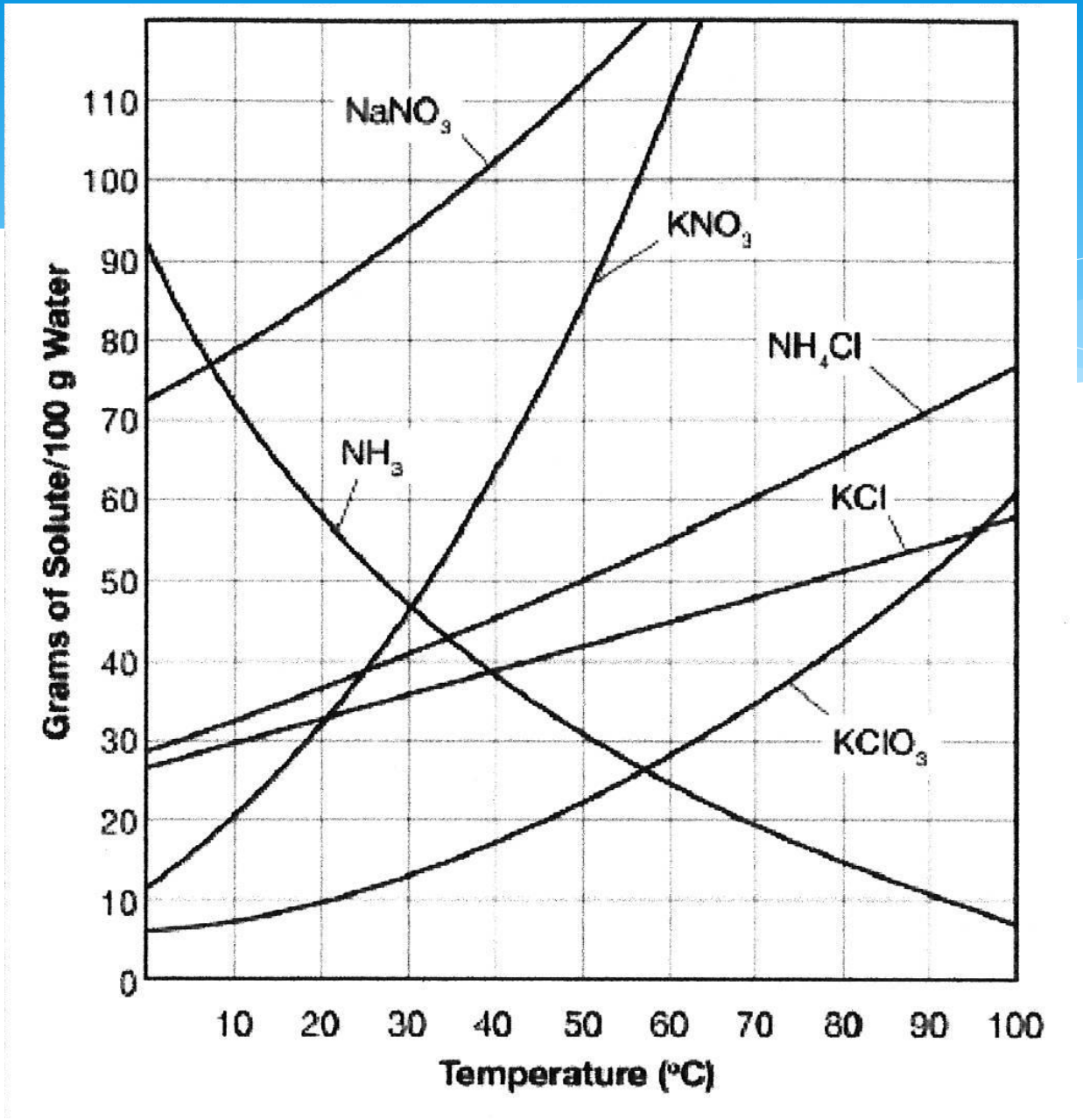
_____temperature

Solubility curves

* Graphs comparing the temperature of the solvent (water) to the saturated amount of solute in grams/100 g H_2O

* Can compare more than one solute at the same time

Solubility Curves



Comparing solubility

* **Saturated** – maximum amount of solute ~ no more can dissolve at that temperature
* **Unsaturated** – less than maximum amount of solute ~ more could dissolve at that temperature
* **Supersaturated** – more that maximum amount of solute ~ adding more will cause all extra solute to un-dissolve

Using the graph…

* **Saturated** – anywhere on a line
* **Unsaturated** – anywhere below the line
* **Supersaturated** – above the line **and** dissolved

Reading the graphs…

* What happens to the solubility as the temperature increases?

* Does this always happen?

Gas graph

* Shows mg of O_2 dissolved in 1000 g H_2O
* What is happening to the amount as temperature Increases?

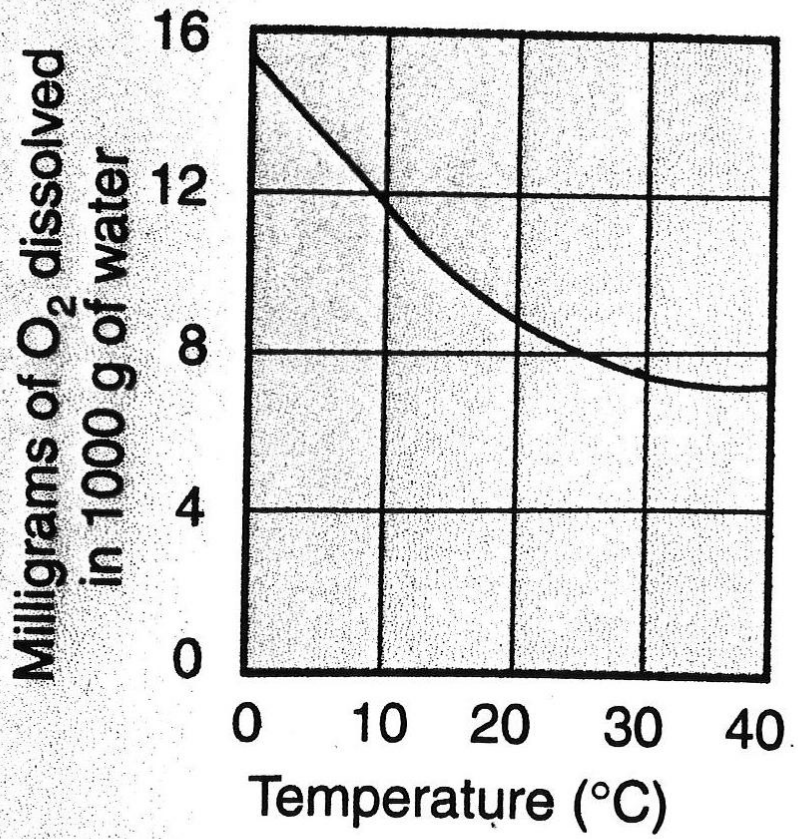


Figure 19 Solubility curve for O_2 gas in water in contact with air.

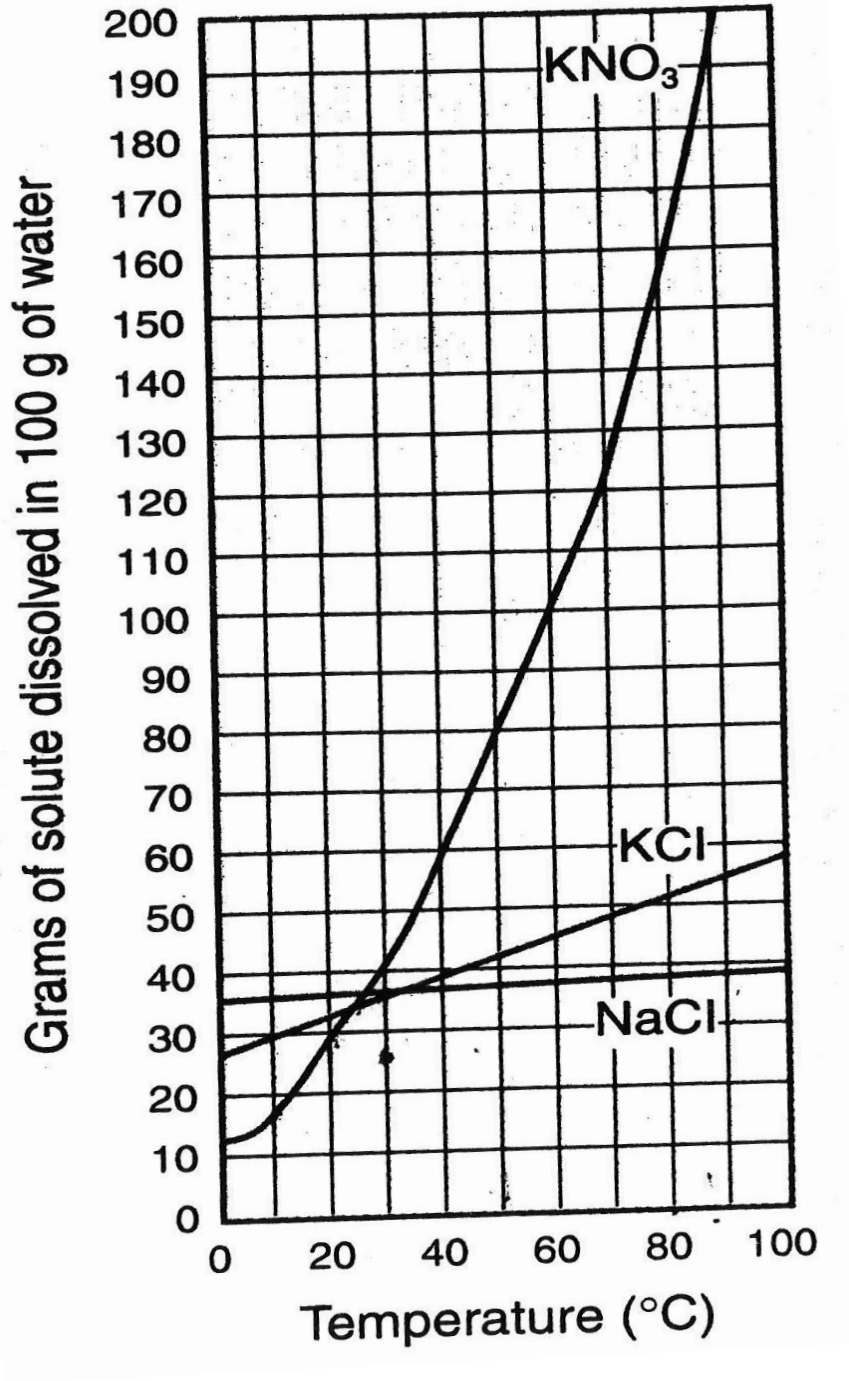
Summary of Solubility and Temperature

* **For solid solutes:** the higher the temperature the **higher** the solubility

* **For gaseous solutes:** the higher the temperature the **lower** the solubility

Let's try some on our own

Do worksheet in packet… pay attention to 6,7,and 10!



Solution concentration

* Relative terms
  * Dilute – not much solute
  * Concentrated – large amount of solute
  * Both of these are very non-specific terms

Specific terms

* Solubility (graphs) – g/100 g H_2O
* % mass = (g solute/ 100 g solution) x 100
* Parts per hundred (pph) g/100 g solution
* Parts per thousand (ppt) g/1000 g solution
  - Parts per million (ppm) g/1,000,000 g solution
  - Parts per billion (ppb) g/1,000,000,000 g solution

  - These are used for small amounts of solute

Oxygen Supply and Demand

* Aquatic Organism (fish, bacteria, frogs, larvae) all need a supply of ***dissolved oxygen*** (DO) to survive
  * They cannot get this oxygen from the water molecules though
* How does O_2 get into the water?
  * Direct dissolving at the surface of the water
  * Aeration – from agitation of the water
  * Photosynthesis from aquatic plants and green algae

DO (dissolved oxygen) and the FISH KILL

* Things to consider…
  * How much O_2 will dissolve in H_2O?
  * How does the temperature of the water affect DO?
  * How much O_2 do fish require?

Competition for O_2

* In all aquatic environments oxygen using organisms will need to compete for available O_2
* Amount of bacteria will be affected by amount of available "food" for them (wastes put there by mankind, dead/decaying natural material)
* The more bacteria there are the more they are using oxygen and the competition is ON!
* Each O_2 using organism has different minimum requirement … ex. Fish require ~ 4 ppm minimum

Temperature and O_2 (a gas) solubility

* Since O_2 is a gas it's solubility is affected by temperature changes that occur in the water
  * Higher temperatures …  DO
  * Cooler temperatures …  DO
* What might cause temperature changes in water?

Let's take a look at the FISH KILL!

* Did thermal pollution have anything to do with the fish kill?
* What does Joe Fisker have to do with DO and the fish kill?
* Let's look at some of his data

Let's look at our report card so far…

* From Joe Fisker's data does it appear that thermal pollution had anything to do with the fish kill?

Other things to consider…

* Acid/Base Contamination
  * Acids and bases are unique compounds because of their affect on water when they are dissolved in it (they are SOLUTES!)
  * Acids almost ALWAYS start with an H (hydrogen)
  * Bases usually end in –OH (hydroxide ion)

Acids, Bases, and pH

* pH is a scale used to tell if a solution is an acid or base
* pH goes from 0 – 14
  * Acids – pH 0 – 6.9
  * Neutral – pH 7
  * Bases – pH 7.1 - 14

Acids, Bases, and THE FISH KILL!

* Most fish can tolerate a pH from 5 – 9
* The pH of the Snake river was measured at the time of the fish kill to range from 6.7 – 6.9
* Conclusion… pH levels (acid/base content) were NOT responsible for the fish kill

So what else might be dissolved in the water that killed the fish?

* Ions and Ionic compounds
  * Ions are charged particles
    * + charged ions are called *CATIONS*
    * - charged ions are called *ANIONS*
  * Cations and anions together form a neutral compound called and IONIC COMPOUND

Ionic Formulas

* Monoatomic ions – contain one type of element (one capital letter) Na^{+1}, O^{-2}, Mg^{+2}
* Polyatomic ions – contain two or more types of elements (two or more capital letters) SO_4^{-2}
* Ionic compounds must have a final charge of ZERO
* To do this we will use a "criss-cross" method

Criss-cross method…

* Write symbols of each ion
* Put the charge above the symbol and circle the number (not the + and -)
* Put parenthesis around (polyatomic ions)
* Reduce charge numbers if possible
* Criss-cross the circled numbers (not the + and -) and write them as subscripts

Example…

* Calcium chloride

* Aluminum nitrate

Now lets reverse the process… Naming ionic compounds

* Use the chart and write the name of each ion as it is written on the sheet in the order that they appear in the formula.
* Ignore the numbers!!!

Examples

* CaO …..

* NH_4NO_3 …

Covalent compounds dissolved in the water may have killed the fish?

* **Covalent compounds** are formed when atoms share electrons… there are NO ions
* Some of these compound will dissolve in water

Writing formulas for covalent compounds

* Use Greek prefixes (found on your cheat sheet)
  * Mono=1
    Di=2
    Tri=3
    deca = 10
    Tetra=4
    Penta=5
    hexa=6
    hepta = 7
    octa = 8
    nona = 9
* Prefix becomes the subscript written next to the element… DO NOT CRISS CROSS!

Naming Covalent compounds

* The first element only gets a prefix for 2 atoms or higher
* The second element gets a prefix for all numbers
* The second element's ending gets changed to -ide.