Precipitation reaction (sodium hydroxide and barium nitrate)

Posted by Anonymous on Thu, 2015-11-19 18:50

Precipitation reaction (sodium hydroxide and barium nitrate): I wonder if you can help me out with another confusing chemical reaction we have observed in our lab.

When sodium hydroxide was added to barium nitrate we expected a clear solution as the WACE chemistry data sheets and our MSDS for barium hydroxide indicate that it is soluble, as are all nitrates.

However a white precipitate formed.

Can you tell me what is going on?

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7
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Laboratory Technicians

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Answer by Poonam hosany on question Precipitation reaction

Submitted by sat on 23 November 2015

Answer reviewed 17 February 2023

In brief

Theoretically, when an aqueous solution of 0.1 M sodium hydroxide reacts with an aqueous solution of 0.1 M barium nitrate, there should be no visible change as colourless aqueous solutions of sodium nitrate and barium hydroxide are produced.

2 $NaOH + Ba(NO_3)_2$? $2NaNO_3 + Ba(OH)_2$

The majority of time, a faint white precipitate of barium hydroxide is formed. Barium hydroxide is slightly soluble in water and can produce a solution with a concentration of around 0.1 M at room temperature; but barium hydroxide above 0.1 M will be insoluble. The formation of the faint white precipitate can be due to:

- barium hydroxide being moderately soluble in water;
- the concentration of barium hydroxide produced is close to the maximum concentration required for precipitation to occur;
- any inaccuracies that may have happened during the preparation of the reactants;
- the possible presence of carbonate ions in the sodium hydroxide solution forming a barium carbonate precipitate.

Science ASSIST recommendations

- Use solutions of lower concentration to avoid precipitation of barium hydroxide. When using 0.05 M aqueous solutions of barium nitrate and sodium hydroxide, a clear solution is formed—no visible change.
- Ensure that the sodium hydroxide solution used is fresh. Over time, sodium hydroxide solutions may absorb atmospheric carbon dioxide to form carbonate ions and may even precipitate out as sodium carbonate around the neck of the bottle. Barium may react with the carbonate ions to form solid barium carbonate, which is not soluble.
- Substitute barium nitrate for a group 1 nitrate to get a clear solution or to magnesium or calcium nitrate to get a white precipitate.
- Substitute the use of test tubes for this activity and use either an acetate sheet with a table printed on it, Or, spotting tiles to reduce the amount of chemical wastes produced. This method only uses one drop of each reactant and the acetate sheets/spotting tiles can simply be washed. This avoids the need to either treat or collect chemical waste for disposal.
- Keep all containers and bottles sealed when not in use.

Additional Information

Going down group 2, the solubilities of hydroxide increases:

Metal	Solubility of hydroxide
Magnesium	Insoluble
Calcium	Insoluble
Strontium	Sparingly soluble
Barium	Moderately soluble
Radium	Soluble

The solubility product (Ksp) is a numerical measure of solubilities. The Ksp of barium hydroxide at 25° C is 5×10^{-3} mol^3dm^{-6}. From the Ksp, the maximum concentration of Ba^{2+} and OH^- ions that can be mixed before a precipitate forms can be determined.

$Ba(OH)_{2\,(s)}$? $Ba^{2+}_{(aq)} + 2OH^-_{(aq)}$

If X is the number of moles of $Ba(OH)_2$ that dissolves before precipitate forms then;

Concentration of Ba^{2+} = X

Concentration of OH^- = 2X

$Ksp = [Ba^{2+}][OH^-]^2 = 4X^3$ Where [ ] = Concentration

$4X^3 = 5 \times 10^{-3}$

X = 0.107 M ~ 0.1 M

A salt is considered:

Insoluble—if it dissolves in water to give an aqueous solution with a concentration less than 0.01 mol/L

Slightly soluble—if it dissolves in water to give an aqueous solution with a concentration between 0.01 mol/L and 0.1 mol/L.

Soluble—if it dissolves in water to give an aqueous solution with a concentration greater than 0.1 mol/L.

This is an arbitrary scale used in WACE. Values obtained from the above calculations, show that barium hydroxide is just between soluble and slightly soluble salts and will give precipitate at high concentration.
