The Chemical Reactivity of Active Metals with Water

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Purpose

To observe and compare the reactions of the active metals lithium, sodium, potassium, calcium, magnesium and aluminium when combined with water.

Materials

Refer to laboratory exercise "Patterns of Chemical Reactivity" on page 28 of *Addison-Wesley Chemistry 11*. Please note that potassium was added to the metals used.

Procedure

Refer to laboratory exercise "Patterns of Chemical Reactivity" on page 28 of *Addison Wesley Chemistry 11*. Please note that only one beaker was used to test the reactivity of the metals with water, and the beaker was thoroughly rinsed with water before the next metal was tested.

Results

Reactions of Active Metals with Water

Metal	Reaction with Tap Water	pH Colour	Rank of Reactivity (1 is the most, 6 is the least)
Lithium (Li)	Gas formed, lightly bubbling and sizzling, dissovled.	Greenish-blue	3
Sodium (Na)	Ignites in a quick flash, produces gas, bubbles and sizzles, dissolved.	Dark blue	2
Potassium (K)	Ignites for several seconds, sizzles and bubbles vigorously, produces heavy gas, dissolved.	Dark blue	1
Calcium (Ca)	Produces smoke and bubbles, sizzles slowly, dissolved slowly.	Dark blue	4
Magnesium (Mg)	Releases small bubbles.	Light green	5
Aluminium (Al)	No noticeable reaction.	Light green	6

Discussion Questions

1. Lithium and sodium have densities lower than that of water as these metals float in water.

2. Common metals such as iron and copper have high densities. For example, the densities of iron and copper are 7.87(g/m^3) and 8.96(g/m^3), respectively. In comparison, the densities for magnesium and aluminium are 2.7(g/m^3) and 1.74(g/m^3), respectively.

3. The hardness of sodium is significantly lower than that of other common metals. Sodium has a hardness of 0.5 MPa, while silver is 2.6 MPa, iron is 4.0 MPa and manganese is 6.0 MPa.

4. From the observations made from the experiment, calcium was shown to be more reactive than magnesium, sodium was shown to be more reactive than lithium, and sodium was shown to be more reactive than magnesium.

5. Magnesium (2.5 MPa) is harder than calcium (1.75 MPa).

6. Potassium is located one spot beneath sodium. During the experiment it was observed that potassium was more reactive than sodium, thus, if it is assumed that the reactions represent trends in the properties of elements, it can be assumed that elements in their groups are in order top to bottom from least reactive to most reactive. Strontium and calcium are in the same group, and strontium is one spot beneath calcium. Thus, it can be determined that when combined with water, the reactivity of strontium is greater than the reactivity of calcium.

7. It is predicted that caesium is the most reactive metal in the periodic table. The alkali metals are the most reactive group of metals as they have only one electron in their outer most shells. This can be seen from the experiment as sodium was more reactive than magnesium, and potassium was more reactive than calcium. These pairs of metals are on the same period, but only the metal from the alkali group was more reactive than the other in both cases. Thus it is predicted that the most reactive metal will be an alkali metal. As observed and discussed in question 6, the alkali metals located lower on the periodic table are more reactive. This suggests francium is the most reactive metal. However, having an atomic number higher than 83, francium is highly radioactive and very unstable. The element above francium is caesium, which is stable and naturally occurring It is thus predicted that caesium is the most reactive metal.

8. During a reaction, wether a chemical change as occurred or not can be determined by several clues, including the formation of a new gas (bubbles), changes in colour, changes in odour and changes in temperature.

Conclusion

The metals lithium, sodium, potassium, magnesium, calcium and aluminium are in order by their reactivity from most to least, respectively, when combined with water. This order of reactivity can be used to recognize trends in the periodic table. One trend observed is that the metals are in order from the most reactive from the top of their group to the least reactive to the bottom of their group. The alkali metals are more reactive than the metals from other groups, such as the alkaline earth metals containing magnesium and calcium, and the group containing aluminium.