Analysis of Aluminum Potassium Sulfate

Inquiry Guidance and AP* Chemistry Curriculum Alignment

Introduction

Synthesized compounds often undergo a series of characterization techniques or tests to confirm the chemical structure and properties of that particular compound. There are a number of tests that can be performed to verify the identity of a compound. In this experiment, several tests are carried out to determine if sample crystals are aluminum potassium sulfate (alum).

Opportunities for Inquiry

Alum plays a very important role as a food preservative, deodorant, and in the industrial process of paper making and other applications. Once students gain understanding of the industrial importance of alum, examining alum using their own procedures will be a fun challenge! This advanced laboratory incorporates enduring understandings and essential knowledge across three big ideas.

The classic experiment can be transitioned to a guided-inquiry lab by adopting some of the following strategies, which will allow you to release students into the lab with confidence.

- Make it an unknown! Give students the name of the compound they are analyzing, but do not reveal the structure. Provide samples of alum and ask students to design procedures for measuring the melting point and percent water in the compound. Post-lab analysis involves compiling all the data and referring to academic sources to confirm the composition. Scientists often use databases and academic resources to confirm products synthesized in the lab!
- Add additional unknowns! Percent water in a hydrate may be tested on many other compounds, such as copper(II) sulfate pentahydrate, manganese(II) chloride tetrahydrate, and zinc sulfate heptahydrate. Give students the possible identities of their unknown samples. Students can measure the melting point and determine percent water of each and analyze the results to determine the identity of two or more unknowns per group. Inorganic compounds often display beautiful colors!
- Expand the students' horizons to recognize the role of chemists in both synthesizing alum and then analyzing it to verify composition and purity! Provide a detailed experimental overview to the students on how to prepare alum. For a complimentary copy of our *Synthesis of Alum* publication, please contact Flinn Scientific.
- Crystal growing can be an art to the synthetic chemist. As an extension and a fun, cooperative class study, organize a crystal-growing competition. Students will love the beautiful crystals!
- Take away the data tables and post-lab questions. Provide students with a detailed overview of the procedure, focusing on Bunsen burner safety and the amount of sample needed to conduct the experiment. Before students per form the experiment, they will need to consult reference texts and brainstorm to identify the types of data to be collected and the types of analyses to carry out.

Alignment with AP Chemistry Curriculum Framework—Big Ideas 1, 2 and 3

Enduring Understandings and Essential Knowledge

All matter is made of atoms. There are a limited number of types of atoms; these are elements. (Enduring Understanding 1A)

1A1: Molecules are composed of specific combinations of atoms; different molecules are composed of combinations of different elements and of combinations of the same elements in differing amounts and proportions.

1A2: Chemical analysis provides a method for determining the relative number of atoms in a substance, which can be used to identify the substance or determine its purity.

Atoms are conserved in physical and chemical processes. (Enduring Understanding 1E)

1E2: Conservation of atoms makes it possible to compute the masses of substances involved in physical and chemical processes. Chemical processes result in the formation of new substances, and the amount of these depends on the number and the types and masses of elements in the reactants, as well as the efficiency of the transformation.

Forces of attraction between particles (including the noble gases and also different parts of some large molecules) are important in determining many macroscopic properties of a substance, including how the observable physical state changes with temperature. (Enduring Understanding 2B)

2B1: London dispersion forces are attractive forces present between all atoms and molecules. London dispersion forces are often the strongest net intermolecular force between large molecules.

Chemical changes are represented by a balanced chemical equation that identifies the ratios with which reactants react and products form. (Enduring Understanding 3A)

3A2: Quantitative information can be derived from stoichiometric calculations that utilize the mole ratios from the balanced chemical equations. The role of stoichiometry in real-world applications is important to note, so that it does not seem to be simply an exercise done only by chemists.

Chemical reactions can be classified by considering what the reactants are, what the products are, or how they change from one into the other. Classes of chemical reactions include synthesis, decomposition, acid-base, and oxidation-reduction reactions. (Enduring Understanding 3B)

3B1: Synthesis reactions are those in which atoms and/or molecules combine to form a new compound. Decomposition is the reverse of synthesis, a process whereby molecules are decomposed, often by the use of heat.

Learning Objectives

1.1 The student can justify the observation that the ratio of the masses of the constituent elements in any pure sample of that compound is always identical on the basis of the atomic molecular theory.

1.3 The student is able to select and apply mathematical relationships to mass data in order to justify a claim regarding the identity and/or estimated purity of a substance.

1.17 The student is able to express the law of conservation of mass quantitatively and qualitatively using symbolic representations and particulate drawings.

1.19 The student can design, and/or interpret data from, an experiment that uses gravimetric analysis to determine the concentration of an analyte in a solution.

3.2 The student can translate an observed chemical change into a balanced chemical equation and justify the choice of equation type (molecular, ionic, or net ionic) in terms of utility for the given circumstances.

3.4 The student is able to relate quantities (measured mass of substances, volumes of solutions, or volumes and pressures of gases) to identify stoichiometric relationships for a reaction, including situations involving limiting reactants and situations in which the reaction has not gone to completion.

3.6 The student is able to use data from synthesis or decomposition of a compound to confirm the conservation of matter and the law of definite proportions.

Science Practices

1.4 The student can use representations and models to analyze situations or solve problems qualitatively and quantitatively.

1.5 The student can re-express key elements of natural phenomena across multiple representations in the domain.

2.1 The student can justify the selection of a mathematical routine to solve problems.

2.2 The student can apply mathematical routines to quantities that describe natural phenomena.

4.2 The student can design a plan for collecting data to answer a particular scientific question.

5.1 The student can analyze data to identify patterns or relationships.

6.1 The student can justify claims with evidence.

6.4 The student can make claims and predictions about natural phenomena based on scientific theories and models.

7.1 The student can connect phenomena and models across spatial and temporal scales.

The *Analysis of Aluminum Potassium Sulfate—AP Chemistry Classic Laboratory Kit* is available from Flinn Scientific, Inc.

Catalog No.	Description
AP6354	Analysis of Aluminum Potassium Sulfate—AP Chemistry Classic Laboratory Kit

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