**Sodium Carbonate Stain Fighters**

*Determination of Percent Composition Sodium Carbonate in Household Detergents*

Introduction:

It is uncommon for household cleaning products to have an itemized ingredient list that clearly states the percentages of each ingredient contained in the product; hence, teams of market research chemists run analytical trials to assess the products of competitors and their efficiency in order to guide future product development. ***It will be the goal of your team to determine the percentage of sodium carbonate through reaction with hydrochloric acid and gas stoichiometry.***

Background:

Approximately one-third of the world’s demand for sodium carbonate is for detergents, either in direct production or in the manufacture of other detergent additives, such as sodium tripolyphosphate and sodium silicate, which itself is  important in the manufacturing of zeolites (compounds used to increase the oxygen content in a substance).

The major aim of a laundry detergent is to remove soils and stains from a fabric whilst maintaining its color and integrity. Most soils are acidic by nature, therefore detergents are usually formulated as alkalis. Sodium carbonate (soda ash), due to its level of alkalinity, is used to boost a builder such as sodium tripolyphosphate (STPP) or a zeolite-based formulation, which itself does not provide any alkalinity. Builders soften water such that surfactants, such as detergents, can perform with higher efficiency.

Pre-lab AP scenario: Turn in attached AP problem as part of pre-lab.

Materials:

You should measure out 3.00 grams of detergent. You will need to use this for ALL of your trials - in the end, you should have two precise trials (for the calculated % sodium carbonate in the detergent) - so plan wisely as it may take more than 2 trials.

You will react it with 1.000 M hydrochloric acid. You should ensure that excess hydrochloric acid is used. This can be done by assuming that the detergent is 100% sodium carbonate (which it’s not), and calculating the volume of hydrochloric acid that would react with it.

Possible materials you can use include (but are not limited to):

|  |  |  |
| --- | --- | --- |
| Beaker | Erlenmeyer flask | Graduated cylinder |
| One-hole rubber stopper | Graduated cylinder | Weigh boat |
| Digital balance | Eudiometer | Volumetric flask |

Follow-Up:

Your team will be expected to present the following to corporate:

* A clear procedure for a concise, efficient process to determine the % sodium carbonate.
  + Include laboratory technique, safety measures (including MSDS), and the process for calculations.
* Quantitative data table of measurements and calculated data for each trial.
* Balanced equations for the molecular, complete ionic, and net ionic reactions.
* Calculations for each trial.
  + Determine the pressure of dry carbon dioxide in the eudiometer.
  + Determine the mass of sodium carbonate reacted.
  + Determine the percentage of the detergent comprised of sodium carbonate.
* Error Analysis
  + Carbon dioxide is slightly soluble in water. Use a step-by-step process to explain what this would do (increase or decrease) the calculated percent composition of sodium carbonate in the detergent.

**AP Problem – PRELAB:**

