

Exploring the Law of Conservation of Mass

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Introduction

The concept of the conservation of mass was first “developed by Antione Lavoisier” (Plourde 46). Lavoisier concluded that matter cannot be created or destroyed only changed. For example: if an ice cube melts it will change states of matter from solid to liquid.

However, the mass of the liquid of the melted ice cube will be the same as the former mass of the solid ice cube. The purpose of this experiment was to test the accuracy of Lavoisier’s law. If the law of mass conservation is true, then the reaction between vinegar and sodium hydroxide would measure the same mass as the initial reactants.

Materials

- Plastic measuring cup
- Small watch glass
- Wooden stir stick
- Salsa container lid (to cover the watch glass)
- Plastic teaspoon
- 100 mL glass beaker
- 250 mL glass beaker
- 100 mL Plastic graduated cylinder to measure the liquids in
- Stove
- Small pot
- Mass scale
- Microwave (for the timer)
- Heavy duty safety gloves
- Newspaper (to cover the table)
- Bottled Spring water (Arcadia)
- White distilled vinegar (Heinz)
- White distilled vinegar (Generic)
- Red cabbage
- Sodium hydroxide (from the micro chemistry kit)
- Notebook and pencil to write down the procedure and results

Procedure

- 1) Gather all materials needed
- 2) Put on safety gloves
- 3) Cover the table with newspaper to protect it from any spills
- 4) Add 2 cups of water to the pot and place on the stove to boil
- 5) Measure the mass of the beakers (because the book was slightly vague on this step, both beakers mass was measured)
- 6) Add 60mL of vinegar to the 100-mL beaker
- 7) Add 1 teaspoon of sodium hydroxide to watch glass
- 8) Add cabbage to the boiling water
- 9) Set a timer for 5 minutes and let the cabbage boil
- 10) After the cabbage has boiled allow it to cool for a few minutes
- 11) Carefully pour 50mL of the cabbage water into the 250-mL beaker
- 12) Allow the solution to cool
- 13) Pour 10 mL of the solution into the 100-mL beaker
- 14) The vinegar should turn pink indicating a chemical reaction has taken place
- 15) Place a stirring stick in the beaker and the watch glass on the beaker
- 16) Place the entire arrangement in the mass scale and make note of the amount of mass
- 17) Pour the sodium hydroxide into the beaker
- 18) Stir the solution carefully so as not to lose any of the solution, keep the stirring rod in the beaker.
- 19) At this point a chemical reaction should be observed as the Sodium Hydroxide neutralizes the vinegar.
- 20) Place the entire arrangement back in the mass scale.
- 21) Make note of any temperature change felt on the sides of the beaker
- 22) Read the mass of the arrangement a second time, and make note of it
- 23) Dispose of the chemicals properly and clean up the experiment area

Results:

The results of this experiment were that the mass did not change when both solutions were added together. When the 30 grams of vinegar was added to the 90 grams of cabbage water solution the vinegar-cabbage water solution that was created was measured to be 120 grams and turned a hot pink color.

When the 120 gram vinegar-cabbage water solution was combined with the 30 gram saucer of lye the result weighed in at 150 grams. When the lye was added to the vinegar cabbage water solution the ending solution became hot to the touch. Also, when the lye was added to the vinegar-cabbage water

solution the solution changed colors from pink to lime green. These results and observations are summarized below in Table 1.

Table 1. The mass of all reaction components and sensory observations

Solution	Mass	Observation
Clear Vinegar	30 grams	Clear Color, liquid, cool
Cabbage Water	90 grams	Red Color, liquid, cool
Vinegar-Cabbage Water Solution	120 grams	Hot-pink Color, liquid, lukewarm
Lye	30 grams	White Color, powder
Vinegar-Cabbage Water and Lye Solution	150 grams	Lime Green Color, liquid, Warm

Discussion

The results of this experiment indicate that matter can take varied forms while continuing to retain its original mass. This means that molecules can be combined and recombined into new substances without a change in weight. The ability of matter to retain a constant mass is applicable to many fields of science and engineering (Wikipedia 2015). For example, this concept could be utilized when mechanical engineers design engines for cars and other vehicles. It would be useful to know that the fuel will not lose mass when it is transformed by the engine into energy.

Instead the molecules of the fuel that are unused by the engine are expelled by the vehicles exhaust system. Many times these chemicals become byproducts that can be harmful to the environment. Knowing and understanding the law of the conservation of mass may potentially help engineers design more efficient and less fuel dependent engines. Applying this concept could lead to an overall improvement for environmental conditions.

Due to a misinterpretation of the instructions the water was allowed to come to a boil before the cabbage leaves were added. The instructions directed the cabbage leaves to be placed in the pot before the water came to a boil. This mistake was not discovered until after the experiment had been

conducted. This could have been the cause of the chemical color reaction not occurring. It was originally thought that the initial vinegar brand caused the experiment not to change colors.

However, after changing the brand of vinegar and performing the experiment a second time, the solution remained uncolored insinuating that the vinegar did not cause the complication. If the experiment were attempted again it would be best to explore the possibility that the mix up with the cabbage caused the altered results.

As stated that in the textbook "matter cannot be created or destroyed, it can only be changed (Plourde 46). In *Exploring Creation with Chemistry* an example was given of wood being burned. It was explained that the molecules underwent a chemical reaction and this changed the composition of the wood.

Said reaction transformed the physical state of the wood but the mass of the wood remained the same (Plourde 46). This sodium hydroxide experiment demonstrated the same concept. The end result proved that changing the chemical composition of the matter did not change the mass.

The mass of the sodium hydroxide and vinegar remained the same despite undergoing a change in composition, these results supported Lavoisier's conservation of mass.

References

Plourde. *Exploring Creation with Chemistry 3rd Edition*. 2003. Anderson, IN: Apologia Educational Ministries, 2015. Print.

"Conservation of Mass". Wikipedia. Wikipedia.org. Web. October 2 2015.