

PRETTY IN PINK

Examining the effect of temperature on a chemical titration

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EXPERIMENTAL PURPOSE:

The purpose of this experiment is to see if changing the temperature of sodium hydroxide in a hydrochloric acid titration affects the amount needed to neutralize the titration.

DRIVING QUESTION:

How will changing the temperature of sodium hydroxide in a hydrochloric acid titration affect how many drops it will take to neutralize the titration?

HYPOTHESIS:

I believe that the neutralization of the titration will happen with fewer drops when the sodium hydroxide is heated up. I think this because if the molecules are sped up by the added heat, any mixing will happen faster, which would also make the titration happen faster and with fewer drops. If the molecules are slower with colder sodium hydroxide, they are moving less, which slows down the mixing. This means more drops are needed to make neutralization evident.



MATERIALS:

- Phenolphthalein
- Sodium Hydroxide
- Hydrochloric Acid
- Beakers (10 mL and 50 mL)
- Pipettes
- Hotplate
- Freezer
- Thermometer



EXPERIMENTAL PROCEDURE

- Label three pipettes with the corresponding chemical names to avoid cross-contamination.
- Take hydrochloric acid and use a pipette to pour this liquid into a 10mL beaker.
- Transfer this 10mL of hydrochloric acid into a larger 250 mL beaker.
- Use phenolphthalein pipette to put three drops of phenolphthalein into the large beaker with the hydrochloric acid.

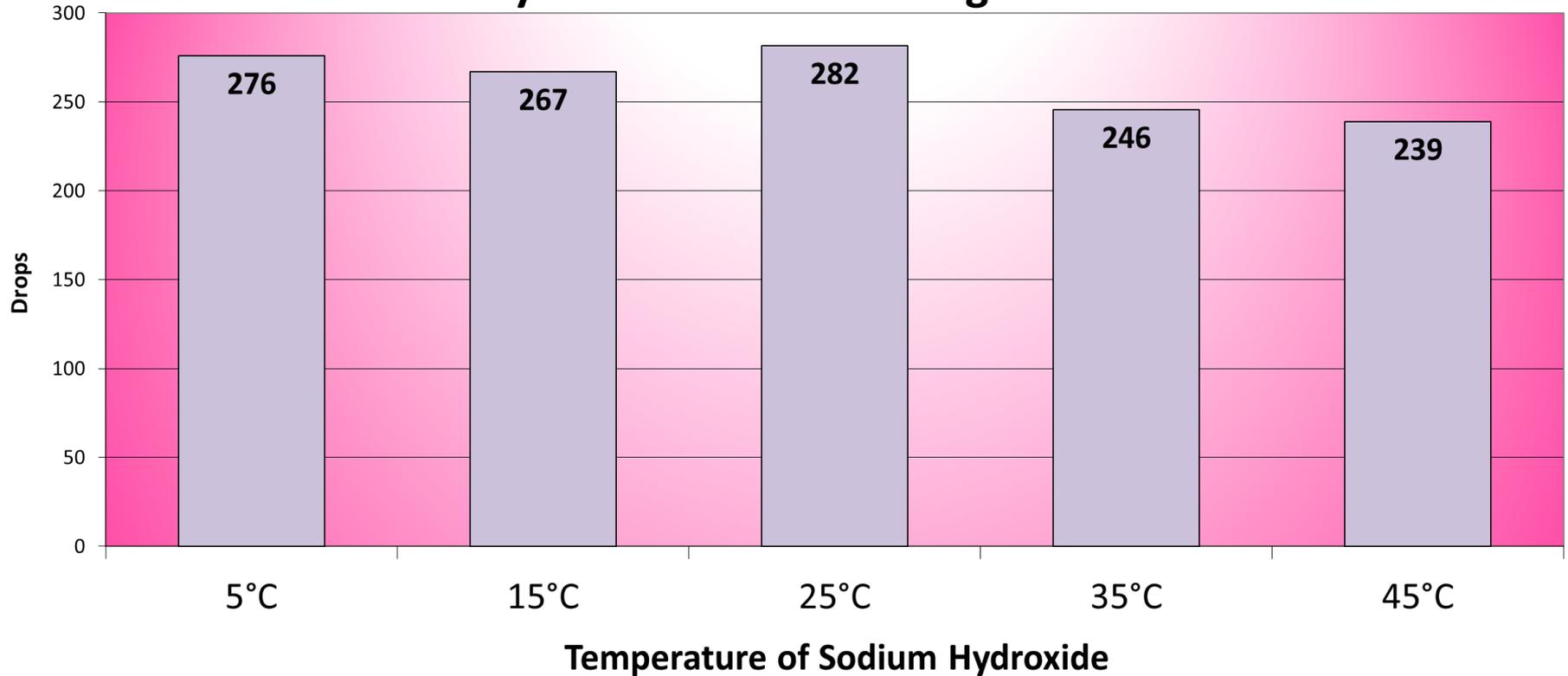
EXPERIMENTAL PROCEDURE (continued)

- Warm up/cool down sodium hydroxide with a hotplate/freezer, based on the temperature you are testing.
- Check temperature of the sodium hydroxide with a thermometer to make sure the tests are accurate.
- Use sodium hydroxide labeled pipette to drop in the chemical one drop at a time, then swirl to mix.
- Count each drop until the color neutralization occurs.
- Repeat the test three times for each of the five temperatures.

**Data: Drops of Sodium Hydroxide Needed to Neutralize
the Hydrochloric Acid at Different Temperatures of
Sodium Hydroxide**

Test	5°C	15°C	25°C	35°C	45°C
1	273	260	291	250	236
2	286	269	285	240	238
3	272	259	269	247	243
Average	276	267	282	246	239

Average Drops of Sodium Hydroxide Needed to Neutralize the Hydrochloric Acid During the Titration



RESULTS: Warm temperatures affect the titration rate, while colder ones not as much.

CONCLUSION:

As the sodium hydroxide is heated up, the number of drops decreases. This proves my hypothesis to be correct. I think this is due to the fact that when liquids are heated, the molecules making up the substance move slightly faster. When they are cooled, the molecules slow down. This cooling results in the substances not mixing as readily as they do when they are warmer, which slightly delays the neutralization.

Added heat increases the speed of the molecules, and when you mix the liquids together, it speeds up the neutralization process. Colder temperatures just delay the mixing somewhat.

REFERENCES:

Sources utilized when collecting background information to understand the components of this titration:

- *edu.rsc.org/experiments/titrating-sodium-hydroxide-with-hydrochloric-acid*
- *lcms.cz/labrulez-bucket-strapi-h3hsga3/an_t_236_download_5bdbac322f*
- *www.titrations.info/acid-base-titration-sodium-hydroxide*
- *sciencenotes.org/phenolphthalein-indicator*
- *dept.harpercollege.edu/chemistry/chm/100/dgodambe/disk/labtech/titrate.htm*