STANDARD OPERATING PROCEDURE:

Preparing sodium hydroxide solutions

Note: To be undertaken only by trained personnel in conjunction with a current Safety Data Sheet (SDS) and site-specific risk assessment.

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1. Introduction

Sodium hydroxide (NaOH) is a hazardous chemical and must be treated with care. It is highly corrosive to skin and eyes and extremely toxic if ingested. The solid can be purchased as pellets, flakes or mini pearls. It is very hygroscopic (absorbs water from the air) and will also absorb carbon dioxide from the air and therefore cannot be used as a primary standard for titrations. To minimise its absorption of water and carbon dioxide, it should be kept in a tightly closed container and left open for as little time as possible.

Dissolving sodium hydroxide in water is an exothermic (heat producing) reaction.

Synonyms: caustic soda, lye, soda lye.

2. Context

- These instructions are for the use of experienced teachers and technicians only.
- Do not make up a solution for the first time without seeking practical advice from an experienced colleague.

3. Safety Notes

- This activity may only be carried out with appropriate facilities available i.e. running water, chemical safety/eyewash station and relevant Personal Protective Equipment (PPE)
- Conduct procedure in a well-ventilated area or fume cupboard.
- Avoid contact with skin and eyes, and avoid breathing fumes.
- The preparation of sodium hydroxide solutions liberates heat and may produce caustic fumes/vapours.
- Ensure that glassware is free from chips and cracks before use.
- For first aid, accident and spill procedures refer to SDS before making a solution.
- **Always add solid sodium hydroxide to water (never water to sodium hydroxide).**

4. Regulations, Licences and Permits

Not applicable

5. Equipment

- Fume cupboard (preferable) or a well-ventilated area
- PPE (lab coat, safety glasses or face shield, chemical resistant gloves e.g. nitrile or latex, closed in shoes)
- Sodium hydroxide

- Distilled/de-ionised water and wash bottle
- Large (2L) borosilicate glass beaker (a capacity of 50% greater than the volume required)
- Small borosilicate glass beaker (for weighing sodium hydroxide)
- Large (1L) glass measuring cylinder or volumetric flask
- Stirring rod or magnetic stirrer and magnetic stirring bar
- Pre-labelled storage bottle with a plastic screw cap lid or stopper.
- Large trough or bucket containing cold water to act as a water bath to cool solutions of 1M or stronger

Note: For laboratory `Stock' solutions use measuring cylinders. For greater accuracy use volumetric flasks and pipette. Sodium hydroxide cannot be used as a primary standard.

6. Operating Procedure

To make 1 litre of stock solution:

1. Wear PPE and work at a fume cupboard or in a well-ventilated area.
2. Place about 650mL of distilled water (or about two-thirds of the final required volume) into the large beaker.
3. Place the beaker into a cold water bath and ensure that it will not tip. If using a magnetic stirrer, set the water bath on the magnetic stirrer before placing the beaker into the bath.
4. Weigh the required amount of sodium hydroxide in the small beaker; see table below.
5. Add small amounts at a time of sodium hydroxide to the solution in the large beaker, stirring with each addition.
6. Check the temperature of the solution to see that it is not too hot before each addition.
7. When all the sodium hydroxide has been added rinse the small beaker with water from the wash bottle.
8. When the solution has cooled to room temperature, transfer it to a 1 litre measuring cylinder or volumetric flask. Rinse the large beaker and stirring rod or magnetic stirring bar with distilled water and add the rinsings to the solution in the measuring cylinder or volumetric flask. Make up the volume to 1 litre.
9. Pour this solution into the pre-labelled bottle that has a plastic screw cap lid (or stopper).
10. On completion of the activity, clean up spills or splashes with plenty of water and thoroughly clean all used equipment and the bench or fume cupboard surface.

Table: Mass of NaOH required to prepare 1L of dilute solution

Molarity required	Mass of solid NaOH
0.1M[a]	4.0g
0.5M[a]	20.0g
1M	40.0g
2M	80.0g
6M[b]	240.0g

[a] 0.5M solution can be prepared by a 1 part in 2 dilution of the 1M solution and a 0.1M solution by a 1 part in 10 dilution of the 1M solution.
[b] CAUTION: creates a lot of heat

7. Trouble shooting/Emergencies

- First aid: See latest SDS for more detailed information
  - **If swallowed:** Do not induce vomiting. Rinse mouth with water, and then give water to drink. Seek urgent medical attention.
  - **If in eyes:** Hold open and irrigate with copious quantity of water for at least 15 minutes. Seek urgent medical attention.
  - **If on skin/clothes:** Remove contaminated clothes and drench the area with excess water under a safety shower. Seek medical attention.
  - **If inhaled:** Remove to fresh air and seek urgent medical attention if breathing difficulties are obvious.
  - For further advice contact the Poisons Information Centre on 131126.
- To minimise absorption of water and carbon dioxide from the air, the container of solid sodium hydroxide should be kept tightly closed when not in use.
- Make sure the solution is well mixed. On dissolving, the more concentrated (and denser) solution may sit on the bottom.
- **Ensure that the solution is not stored in a glass bottle with a ground glass stopper.** Strong alkali solutions can 'freeze' ground glass stoppers in place.

8. Waste Disposal

- Clean up any small spillages immediately with plenty of water. (Larger spills should be neutralised with an acid).
- Concentrated solutions should first be diluted by addition to a larger volume of water. Neutralise waste with dilute acetic acid (or vinegar), citric acid or dilute hydrochloric acid, so that the pH is in the range pH 6-8. Use an indicator such as Universal Indicator to determine the pH. Wash the neutralised diluted solution to waste down the sink with excess cold water.
- Larger quantities will need to be collected and disposed of by a registered hazardous waste disposal company.

9. Related Material

- Manufacturer's safety data sheet.
- Risk Assessment.

References:

Chemwatch Gold. 2011. *Chemwatch Independent Material Safety Data Sheet: Sodium hydroxide.* http://www.chemwatch.net (Subscription required accessed February 2014)

Risk Assess. 2014. *Risk Assessment for making 1M NaOH* http://www.riskassess.com.au/ (Subscription required accessed February 2014)

History of reviews:

Date	Version Number	Notes
April 2014	Version 1.0	
Nov 2015	Version 2.0	Text box for 6. Operating Procedure enlarged to reveal footnote 'b' Additional synonyms included
Nov 2016	Version 3.0	Additional instructions for rinsing the stirring rod/magnetic stirring bar