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Nitrogen in Lawn Fertilizer

The stability of nitrifying bacteria exposed to variation in temperature and excess moisture, altering total nitrogen mass in soil samples.

Biological nitrification rates increase with rising temperature until an optimal temperature is reached; as the temperature exceeds the soil's tolerance capacity, the activity of most organisms, as well as bacteria, reduces significantly and very little microbial activity occurs. This investigation attempts to prove the many speculations in relation to nitrification rates in soil when influenced by temperature and excess moisture. The final results indicated that the soil samples exposed to extreme high and low temperatures retained a higher percentage of nitrogen; and samples tested with no excess moisture bore a greater value of nitrogen, although small, when compared to samples doused with excess water. Although these results collide with the ideal values that were found during research, they can be explained through systematic error and further in the Data Analysis section.

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Aim

This investigation is designed to analyse a brand of lawn fertiliser, Aquasol, for its nitrogen content after being subjected in potting mix for a period of seven days' time; during this time the samples are exposed to variances of temperature and moisture content.

Hypothesis

The growth and activity of nitrifying bacteria is directly proportional to the change in soil temperature and excess moisture. It is hypothesized that the samples exposed to a natural, fluctuating room temperature will be most effective in promoting the growth of nitrifying bacteria; and the solution will comprise of a higher mass in nitrogen. The extreme temperatures that lie out of this range will either abolish or immobilize available nitrifying bacteria, producing a notably lower value of nitrogen mass than the control. It is also hypothesized that there will be a decrease of nitrifying activity in fertilised soil samples saturated with excess water due to restrictions in oxygen availability.

Procedure

Brief summary

Nitrification activity solely relies on the environmental condition the fertilised soil is in. This practical experiment involved the addition of Aquasol lawn fertiliser in fifty grams of potting mix; with an identical batch subjected to extra moisture, i.e. 20mL of water was added. Each of these sets were exposed a set temperature, whether they were placed in incubators, fridges or at room temperature. The desirable temperature variations were set at 3°, 9°, 28°, 40° and 60°. After seven days, the samples were sieved, filtered and boiled. The boiling process should drive off ammonia gas and a reaction with a known excess of aqueous sodium hydroxide, followed by back titration with hydrochloric acid will determine how much of the alkali remains unreacted. Further calculations made from the experimental results will determine the validity of the research hypothesis.

Experiment for control set (Day 0):

- 1. Fifty grams of potting mix was weighed and transferred over to eight deionised 100ml beakers.
- 2. 10ml of an Aquasol solution (1.2g/250ml) was instilled into each beaker.
- 3. Four beakers marked "Moisture" was injected another 20ml of distilled water while the other four marked "No moisture added" was left as it was.
- 4. All beakers were cling-wrapped and left for approximately half an hour.
- 5. Experimental titration for nitrogen (below) was carried out when ready.

Experiment preparation for incubator/fridge/room temperature variables:

- 1. Eight 100ml deionised beakers were wrapped securely with aluminium foil and labelled according to a temperature variable (3°, 9°, 28°, 40° and 60° Celsius).
- 2. Fifty grams of potting mix was weighed and transferred over to all eight beakers.
- 3. 10ml of an Aquasol solution (1.2g/250ml) was instilled into each beaker.
- 4. Four of the beakers marked "Moisture" was injected another 20ml of deionised water while the other four marked "No moisture added" was left as it was.
- 5. All beakers were cling-wrapped on top and an extra layer of aluminium foil was positioned on top the cling wrap with small holes poked through for O_2 .
- 6. All beakers left in the incubator or fridge was set to one of the favourable temperatures indicated above and was left for seven days before titrating.

Experimental titration for Nitrogen

- 1. 50ml of deionised water was added to the content of all eight beakers after seven days of being subjected to a temperature variable.
- 2. A deionised metal spoon was used to rapidly mix the mixture.
- 3. After 20-30 seconds, the muddy content was poured into a sieve held over the top of a large 500ml deionised beaker. The remaining solid fragments of potting mix were discarded after no more fluid trickled down.
- 4. The sieved solution was then filtered into a 250ml deionised beaker using filter paper and a funnel.
- 5. 10ml of the filtered solution was measured and transferred over a conical flask where the liquid-line was marked before setting to boil on a hotplate. A glass funnel was set on the lip of the flask.
- 6. The mixture was boiled for 10 minutes and was relocated to cool on a heat-proof mat for 5 minutes and then placed in an icy water bath.
- 7. A 25ml aliquot of 0.1M Sodium Hydroxide (NaOH) was pipetted into the flask, along with 2-3 drops of phenolphthalein indicator.
- 8. Solution titrated against 0.1M Hydrochloric acid (HCl) until the equivalence point was reached, or until the pink solution was dispelled to a clear liquid.



Figure 2: The basic diagrammatical method in carrying out the experiment.

Standardisation of Sodium Hydroxide

- 1. 2.6 grams of potassium hydrogen phthalate or KHP (KOOC₆H₄COOH) was weighed atop filter paper on a balance.
- 2. Deionised water was used to wash this solute into a 100mL volumetric flask using a dry, deionised glass funnel.
- 3. The KHP solution was made up accurately to 100mL. The solution in the volumetric flask was stoppered and inverted repeatedly until all KHP has dissolved.
- 4. A 25mL aliquot of this KHP solution was pipetted into three separate conical flasks. Excess/unneeded/remaining solution was discarded.
- 5. 1-2 drops of phenolphthalein indicator was added to each conical flask.
- 6. A deionised burette was lined with sodium hydroxide before titrated with the KHP solution in the flasks. The flasks were titrated until the solution turned to a faint pink colouring for more than 30 seconds.
- 7. The volume reading at the end of the titration was recorded and calculations were concluded (original recordings can be found in experiment logbook).

Materials*

- 16 conical flasks
- 10 500mL beakers
- 16 100mL beakers
- 8 250mL beakers
- 9 glass funnels
- 2 100mL measuring cylinders
- 2 10mL measuring cylinders
- 2 hotplates
- 2 heatproof mats
- 2 metal tongs
- 2 pipettes
- 2 burettes
- 2 droppers
- 2 refillable wash bottles

- 1 clamp
- 1 stand
- 1 weight balance
- 1 sieve
- 1 waste box (ice-cream tub)
- 1 box of filter paper
- 1 box of sticker labels
- 1 metal spoon
- 1 100mL volumetric flask
- 1 metal spatula
- 1 thermometer
- 1 box of aluminium foil
- 1 box of pH indicator
- 1 box of glad wrap

*Note that different equipment was used for different days and not everything was needed at one instance.

Chemical Required

Approximately the following:

- 2.5kg of potting mix
- 1.5L of 0.1M Sodium Hydroxide (NaOH)
- 1.5L of 0.1M Hydrochloric Acid (HCl)
- <100mL of Phenolphthalein Indicator
- >3L of distilled water
- 2.4g/500mL Aquasol Lawn Fertiliser
- 2.6g of KHP
- Icy water tub

Experimentation Results

The original copy of experimental results can be alternatively provided in the Logbook.

		V	olume of hydroch	loric acid (mL	.)
	DAY 0		Trial	S	
		1	2	3	Average
26°C	No moisture	24.9	24.3	25.2	24.8
	Moisture (+20mL)	26.4	25.9	25.7	26

Figure 3: Day 0 (control)

		Volume of hydrochloric acid (mL)				nL)
Temperature variables				Trials		
		1	2	3	4	Average
03°C	No moisture	24.3	24.3	24.1	24.2	24.23
	Moisture (+20mL)	24	24.4	24.3	24.3	24.25
09°C	No moisture	24.1	24.4	24.4	24.2	24.275
	Moisture (+20mL)	24.5	24.3	24.2	24.2	24.3
28°C	No moisture	25.2	25.3	28.2**	25.2	25.23
	Moisture (+20mL)	25.5	25.5	25.3	25.1	25.35
40°C	No moisture	25.6	25.2	25.3	25.5	25.4
	Moisture (+20mL)	25.7	25.4	25.3	25.5	25.475
60°C	No moisture	23.8	24.2**	23.8	23.3	23.6
	Moisture (+20mL)	23.6	23.9	24	23.7	23.8

Figure 4: all the temperature variables that were tested after one week

	Volume	Volume from standardisation of NaOH (mL)			
	Trials				
	1	2	3	Average	
Volume of NaOH (mL)	34.8	32.9	31.2	32.97	

Figure 5: standardisation of sodium hydroxide

**trial value omitted in for average calculation

INVESTIGATION OF NITROGEN IN LAWN FERTILISER

Temperature variables	Mass of Nitrogen (x10 ⁻³ g/10mL)		
	No moisture	Moisture (+20mL)	
DAY 0	1.2	0.5	
03°C	1.99	1.96	
09°C	1.93	1.89	
28°C	0.59	0.42	
40°C	0.35	0.25	
60°C	2.87	2.59	

Figure 6: mass of nitrogen derived from samples ($x10^{-3}g/10mL$ Aquasol). Calculations can be found in the next section. Note that Day 0 is the control sample.



Figure 7: graph displaying mass of nitrogen in sample variable

These graphed values of nitrogen mass can be found in the **Calculations Section.**

Calculations

<u>Calculations for the standardisation of sodium hydroxide (NaOH):</u>

Burette reading of sodium hydroxide [NaOH] (mL)					
Trials	1	2	3		
	34.8	32.9	31.2		
Average	32.97				

1. Calculate the average NaOH reading from titration trials with KHP:

Average NaOH =
$$\frac{34.8 + 32.9 + 31.2}{3}$$

Average
$$NaOH = 32.97mL$$

2. Calculate the amount (mol) of KHP in the sample:

$$n_{KHP} = \frac{m_{KHP}}{MM_{KHP}}$$

$$n_{KHP} = \frac{2.6g}{(39.10) + (4 \times 16.00) + (5 \times 1.008) + (7 \times 12.01)}$$

$$n_{KHP} = \frac{2.6g}{192.22g/mol}$$

$$n_{KHP} = 0.013527 \text{ mol KHP}$$

3. Use the ratio in the balanced equation to determine the amount of NaOH needed:

$$NaOH_{(L)} + KHP_{(L)} \rightarrow NaKP_{(L)} + HOH_{(L)}$$

 $\therefore n_{NaOH} = n_{KHP} = 0.013527mol$

4. Calculate the KHP in an aliquot (25mL):

Then a 25mL aliquot contains x moles

$$\therefore \frac{100mL}{25mL} = \frac{0.013527mol}{x}$$
$$x = \frac{0.013527mol \times 25mL}{100mL}$$
$$x = 0.0033818 mol$$

5. Calculate the concentration of NaOH in mol/L:

$$C_{NaOH} = \frac{n_{NaOH}}{V_{NaOH}}$$
$$C_{NaOH} = \frac{0.0033818 \text{ mol}}{0.03297L}$$

$C_{NaOH} = 0.1026M NaOH$

Calculations for nitrogen content for DAY 0: (done for all average figures from fig 4)

	V	olume of hydroc	hloric acid (mI	Ĺ)
DAY 0		Tria	ıls	
	1	2	3	Average
No moisture	24.9	24.3	25.2	24.8
Moisture (+20mL)	26.4	25.9	25.7	26

Mass of fertiliser sample = 0.048g

Volume of NaOH added = 25mL

Concentration of NaOH = 0.1026M

Concentration of HCl = 0.1M

Average volume of HCl for "No moisture sample" = 24.8mL

1. Calculate the average volume for hydrochloric acid:

Average HCl = $\frac{24.9 + 24.3 + 25.2}{3}$ Average HCl = 24.8 mL

2. Calculate the amount (mol) of NaOH:

 $n_{NaOH} = C_{NaOH} \times V_{NaOH}$ $n_{NaOH} = 0.1026M \times 0.025L$ $n_{NaOH} = 0.002565mol NaOH$

3. Calculate the amount (mol) of HCl used with excess NaOH:

$$n_{HCl} = C_{HCl} \times V_{HCl}$$
$$n_{HCl} = 0.1M \times 0.0248L$$

 $n_{HCl} = 0.00248 mol HCl$

4. Use the ratio to work out the amount of excess NaOH:

 $NaOH_{(L)} + HCl_{(L)} \rightarrow NaCl_{(L)} + HOH_{(L)}$

 $\therefore n_{NaOH \ excess} = n_{HCl} = 0.00248mol$

5. NaOH reacting with ammonia (NH_4^+) :

$$n_{NaOH} = total NaOH - excess NaOH$$

 $n_{NaOH} = 0.002565 - 0.00248$

$$n_{NaOH} = 0.000085mol = 8.5 \times 10^{-5}mol$$

6. Use the balanced equation to see how much NH_4^+ reacted with NaOH:

$$\begin{split} NH_4^+ + NaOH &\to NH_3 + HOH + Na^+ \\ & \therefore n_{NH_4^+} = n_{NaOH} \\ & \therefore n_{NH_4^+} = 8.5 \times 10^{-5} mol \end{split}$$

7. Convert moles of NH_4^+ to mass:

$$\begin{split} m_{NH_4^+} &= n \times MM \\ m_{NH_4^+} &= 8.5 \times 10^{-5} mol \times [(14.01) + (4 \times 1.01)] \\ m_{NH_4^+} &= 0.001534 g \ NH_4^+ \end{split}$$

8. Calculate the mass of nitrogen in ammonia:

 $Mass N = \frac{mass of N}{Molar Mass of NH_4^+} \times mass of NH_4^+$ $Mass N = \frac{14.01}{18.05} \times 0.001534 = 0.0012g N$ $Mass N = 1.2 \times 10^{-3} grams Nitrogen$

All values tabulated in figure 6.

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Appendix A: Photos



Photo credits: Jessica Dinh and Jamie Nguyen 2014

Appendix B: Extra Material

Calculations for mass percentage (increase):

 $\frac{\text{For No Moisture Samples:}}{Control value} \times 100$ % increase = $\frac{Control value}{Experimental value} \times 100$ % increase = $\frac{1.2 \times 10^{-3} g/10mL}{1.99 \times 10^{-3} g/10mL} \times 100$

% increase = 60.3%

For Extra Moisture (+20mL) Samples:				
$\%$ increase = $\frac{Control \ value}{Experimental \ value} \times 100$				
% increase = $\frac{0.5 \times 10^{-3} g/10 mL}{1.96 \times 10^{-3} g/10 mL} \times 100$				
% <i>increase</i> = 25.5%				

		Percentage of nitrogen mass increase				
		No Moisture	Moisture (+20mL)			
DAY 0 Control		1.2 x 10 ⁻³ g/10mL	0.5 x 10 ⁻³ g/10mL			
	03°C	60.3%	25.5%			
Temperatures	09°C	62.2%	26.5%			
	60°C	41.8%	19%			

Figure 8: Nitrogen mass percentage increase.

It can be seen that, from fig 7, only three temperature variables exhibited nitrogen mass higher than the control value of day 0. These are calculated into percentages here. The blue line (from graph) indicates that the control value for soil samples with no excess water. These values are reflected in the first row of figure 8. From 3°C there was a 60.3% increase, at 9° there was a 62.2% increase and at 60°, a 41.8% increase. An increase in nitrogen mass means that there was nitrification activity and even in the most unexpected conditions the bacteria flourished.

The orange line in figure 7 indicates the control value for soil samples saturated with excess water content. The percentage increase of these values are calculated and tabulated on the right of fig 8. It is evident that there are major errors when conducting the control sample soils. Class time was limited (teacher supervision hours were tight in that week) and so the titration was rushed. The end-point was hurried and now, it is assumed to be inaccurate. There is a major difference between the control samples of the moisture and no moisture variables, indicating that it is erroneous. Hence the percentage calculations for "moisture" samples differ greatly from that of the "no moisture" samples. It can be concluded that the values for day 0 control samples fall under the same procedural error/difficulties during the first stages of the investigation as the 28° and 40° samples; and therefore cannot be considered valid results.

Appendix C: Glossary

Ammonification – Production of ammonium (NH₄) from soil organic matter (SOM) decomposition, and other sources.

Ammonium – Form of nitrogen expressed as NH₄, which is a plant available form of N that occurs as part of the N-cycle in soil; occurs from soil organic matter (SOM) decomposition and other sources.

Denitrification – Conversion and loss of nitrate nitrogen to various nitrogen gases when soil becomes saturated with water.

Immobilization – The temporary "tying up" of inorganic N by soil microorganisms decomposing plant residues is not strictly a loss process. Immobilized N will be unavailable to plants for a time, but will eventually become available again as residue decomposition proceeds.

Leaching – Loss of nitrogen in the form of Nitrate-N which is a water soluble, mobile form, with excess water that moves below the root-zone, or to drainage tile.

Mineralization – Organic matter decomposition which releases nutrients in a plant available form (e.g. phosphorus, nitrogen and sulphur).

Nitrate-N – Form of nitrogen expressed as NO_3 , which is a plant available form of N that occurs as part of the N-cycle in soil. Nitrate is the form of N most susceptible to leaching loss.

Nitrification – Part of the nitrogen cycle where soil organisms convert ammonia and ammonium to nitrite and next to nitrate-nitrogen which is available to plants.

Soil Nitrogen Fixation – Conversion of nitrogen in the air to organic N-forms, which occurs either by soil organisms or in association with legumes.

Volatilization – Ammonia nitrogen loss from N-fertilizers and other sources. Loss can be especially high when N-fertilisers containing urea are surface-applied directly on moist residue.

Appendix D: Nitrogen Forms for Gardening

Form of nitrogen	Source	Availablity to plants	Remarks
Organic nitrogen (Proteins, amino acids)	 Animal manure Compost Plant residues Blood meal Many others 	Not available until broken down—weeks to years.	Immobile in soil. Slowly converted to NH4 ⁺ in soil.
Urea	Commercial fertilizerFresh manure	Available fairly quickly as ammonium.*	Rapidly converted to NH₄⁺ in soil.
Ammonium (NH₄⁺)	 Chemical fertilizers such as ammonium nitrate & ammonium sulfate Fresh manure Breakdown of organic matter in soil 	Used directly by some plants; more so under acidic conditions.*	Can adsorb to clay or organic matter, reducing leaching. Converted to NO ₃ ⁻ by soil organisms.
Nitrate (NO ₃ ⁻)	• Chemical fertilizers such as ammonium nitrate & potassium nitrate	Used directly by most plants.*	Highly mobile in water. Easily leached to ground- water.
Nitrogen gas (N2)	• About 80% of air within soil spaces	Only available to plants with nitrogen-fixing bacteria, such as legumes.	Organic nitrogen and NH4 ⁺ are added to soil from legumes.

Figure 9 Common forms of nitrogen for garden management.

*Slow-release formulations are available that prolong availability to plants.

Source: Andrews 1998

Appendix E: Chemical MSDS Sheets





Material Safety Data Sheet Hydrochloric acid, 20%(v/v) MSDS

Section 1: Chemical Product and Company Identification				
Product Name: Hydrochloric acid, 20%(v/v)	Contact Information:			
Catalog Codes: SLH2932	Sciencelab.com, Inc.			
CAS#: Mixture.	Houston, Texas 77396			
RTECS: Not applicable.	US Sales: 1-800-901-7247			
TSCA: TSCA 8(b) inventory: Hydrochloric acid; Water	International Sales: 1-281-441-4400			
CI#: Not applicable.	Order Online: ScienceLab.com			
Synonym:	CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300			
Chemical Name: Not applicable.	International CHEMTREC, call: 1-703-527-3887			
Chemical Formula: Not applicable.	For non-emergency assistance, call: 1-281-441-4400			

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:

In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:

Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 7: Handling and Storage

Precautions:

Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as alkalis, moisture. May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

"Hydrochloric Acid MSDS" (2013) http://www.sciencelab.com/msds.php?msdsId=9925956





Health	3
Fire	0
Re a ctivity	2
Personal Protection	J

Material Safety Data Sheet Sodium hydroxide, Pellets, Reagent ACS MSDS

Section 1: Chemical Product and Company Identification		
Product Name: Sodium hydroxide, Pellets, Reagent ACS	Contact Information:	
Catalog Codes: SLS4090	Sciencelab.com, Inc. 14025 Smith Rd. Houston, Texas 77396	
CAS#: 1310-73-2		
RTECS: WB4900000	US Sales: 1-800-901-7247	
TSCA: TSCA 8(b) inventory: Sodium hydroxide	International Sales: 1-281-441-4400	
CI#: Not available.	Order Online: ScienceLab.com	
Synonym: Caustic Soda	CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300	
Chemical Name: Sodium Hydroxide	International CHEMTREC, call: 1-703-527-3887	
Chemical Formula: NaOH	For non-emergency assistance, call: 1-281-441-4400	

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:

In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:

Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 6: Accidental Release Measures

Small Spill:

Use appropriate tools to put the spilled solid in a convenient waste disposal container. If necessary: Neutralize the residue with a dilute solution of acetic acid.

Large Spill:

Corrosive solid. Stop leak if without risk. Do not get water inside container. Do not touch spilled material. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of acetic acid. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

"Sodium Hydroxide MSDS" (2013) http://www.sciencelab.com/msds.php?msdsId=9924997

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MATERIAL SAFETY DATA SHEET Potassium hydrogen phthalate

Section 3 - Hazards Identification		
EMERGENCY OVERVIEW		
	Not available	
Potential Health Effects		
Eye:	May cause eye irritation.	
Skin:	May cause skin irritation. May be harmful if absorbed through the skin.	
Ingestion:	May cause irritation of the digestive tract. May be harmful if swallowed.	
Inhalation:	May cause respiratory tract irritation. May be harmful if inhaled.	
Chronic:	No information found.	
Section 4 - First Aid Measures		
Eyes:	Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. If irritation develops, get medical aid.	
Skin:	Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid if irritation develops or persists.	
Ingestion:	Do not induce vomiting. Get medical aid if irritation or symptoms occur.	
Inhalation:	Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid if cough or other symptoms appear.	
Notes to Physician:		
Section 5 - Fire Fighting Measures		
General	As in any fire, wear a self-contained breathing apparatus in pressure-demand,	
Extinguishing Media:	Use water spray, dry chemical, carbon dioxide, or chemical foam.	

Section 7 - Handling and Storage

Handling: Use with adequate ventilation. Minimize dust generation and accumulation. Avoid contact with eyes, skin, and clothing. Avoid ingestion and inhalation.

Storage: Store in a cool, dry place. Store in a tightly closed container.

Section 8 - Exposure Controls, Personal Protection

Personal Protective Equipment

Eyes:	Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin:	Wear appropriate protective gloves to prevent skin exposure.
Clothing:	Wear appropriate protective clothing to minimize contact with skin.

"Potassium Hydrogen Phthalate" (2008)

http://www.ch.ntu.edu.tw/~genchem99/msds/exp15/KHP.pdf [accessed 02/04/14]