

Teacher packs in Experimental Science

CHE Pack 1

Purification of '*Kewu*' (Saltpetre)

Pack contents:

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Curriculum areas covered:

- Physical and chemical changes
- Compounds, mixtures, solute and solvents
- Homogenous and heterogeneous mixtures

Title: Purification Of 'Kewu' (Saltpetre)

Target group: Teacher trainee, DBE students

Also suitable for: SHS students

Duration: 45 minutes plus Discussion time

Learning outcomes:

These are the learning outcomes expected after students have gone through this Pack.

1. Knowledge and understanding

KN1 list the stages in the purification of *kewu* salt

KN2 define the terms 'dissolve', 'filter' and 'evaporate'

KN3 list the apparatus used in the purification of *kewu* salt

2. Cognitive skills

CS1 apply knowledge and understanding of the procedure to purifying similar mixtures

3. Key Skills

KS1 calculate percentages, based on data collected

4. Practical skills

After going through this pack the student should be able to

PS1 Able to set up and use appropriate equipment for weighing, dissolving, filtration, and evaporation

PS2 Able to record experimental results

A. Teacher's Guide

Purpose: To purify impure 'kewu' substance using techniques like dissolution, filtration and evaporation.

Preparation

Let the students revise their notes on 'separation of mixtures'.

Equipment/ Materials needed: As listed in Students' Guide

Assessment Questions

1. What physical property of the *kewu* mixture enabled you to separate the two components?
(KN)
(Answer: The salt was soluble in the water, while the dirt was not)
2. List, in order, the stages of the process of purifying the *kewu* salt (one word for each stage).
(KN1)
(Answer: Dissolving, filtering, evaporating)
3. Write a series of instructions for another student to tell them how to separate a mixture of charcoal and ammonium chloride. [or you could use sand and salt, etc. as on your sheet, but not, naphthalene and sand, because I don't think naphthalene is sufficiently soluble in water]
(CS)
(Answer similar to the student instructions on this worksheet)
4. If an initial mixture of sand and salt weighed [or had a mass of] 56.7 g and the purified salt had a mass of 17.3 g, what percentage of the mixture was salt? (KS)
(Answer: percentage of salt = $(17.3 \text{ g}/56.7 \text{ g}) \times 100\% = 30.5\%$)
5. If an initial mixture of *kewu* weighed [or had a mass of] 83.1 g and the dirt in the filter paper had a mass of 34.5 g, what percentage of the mixture was salt?
(Answer: If dirt weighs 34.5 g, then mass of salt, assuming no losses, would be $(83.1 - 34.5) \text{ g} = 48.6 \text{ g}$. So percentage of salt = $(48.6 \text{ g}/83.1 \text{ g}) \times 100\% = 58.5\%$)

(This last question is more demanding because it involves subtraction too. You will almost certainly need to change these percentages to make them more realistic) (PS)

The practical skills can only really be tested by getting the students to separate a different mixture on their own.

B. Student Guide

Purpose: To purify impure 'kewu' substance using techniques like dissolution, filtration and evaporation.

Background Information

Mixtures are not unique to chemistry; we use and consume them on a daily basis. The beverages we drink each morning, the fuel we use in our vehicles, and the ground we walk on are all mixtures. Any material made up of two or more substances that are not chemically combined is a mixture. Some mixtures we encounter are pure but most of them are impure and can be purified. Purification is a process of removing impurities from impure substances or mixtures.

'Kewu' is an impure SOLID MIXTURE of several substances including dirt. It is very common and used during cooking e.g. boiling beans, preparing okra soup, 'waakye' etc. In order to purify *kewu* it is necessary to remove the insoluble dirt from the soluble salts. The removal of the impure dirt from the rock salt requires certain basic techniques, like dissolution, filtration and evaporation.

Dissolution is the process by which a solid (solute) is dispersed homogeneously in a liquid (solvent) to form a homogeneous mixture e.g. dissolving common salt or sugar in water.

Filtration is the removal of insoluble solids from liquids or solutions. e.g. removal of chalk suspensions from solutions, removal of sand particles from drinking water.

Evaporation is the separation/removal of solvent from a homogeneous mixture. Amorphous substances are separated by evaporation to dryness. Crystalline substances are separated by concentrating the solution by evaporation, then crystallizing the concentrated solution. Salt is separated from brine by evaporation.

[Note: The method described below could be used to separate any two substances when one of them can dissolve in water and the other cannot]

Equipment/ Materials needed

- About 3g of impure 'kewu' salt
- Portable heat source (e.g. kerosene stove, coal pot, gas stove, hot plate, any other)
- Water
- Beaker/drinking glass
- Evaporating basin/kitchen saucepan
- 100ml graduated cup/100ml measuring cylinder
- Funnel
- White linen/filter paper
- miniature mortar/earthenware bowl and pestle/ 'tapore'
- measuring cylinder/ suitable alternative (graduated cups for liquid medicines)

Other requirements

Working bench/table, Open space, Laboratory coat, Eye goggles, Hand gloves.

Instructions

Revise your notes on separation of mixtures

Experimental Procedure

- CRUSH the *kewu* salt using the miniature mortar and pestle / earthenware bowl to a fine powder.
- Weigh 2.5g of the powdered salt into a beaker/ glass and add 50ml of warm water measured using graduated cup/measuring cylinder and STIR. The salt will DISSOLVE into the water but the dirt, which is insoluble in water, will not.
- FILTER the mixture using filter paper/white linen and funnel. The dirt will remain in the filter paper as a **residue** and the clear SALTY SOLUTION will drip through and form the filtrate.
- Transfer the filtrate into an evaporating basin/kitchen sauce pan
- HEAT the filtrate until it has been reduced to about $\frac{1}{4}$ volume.
- Remove the heat source and filter WHILE HOT.
- Allow the filtrate to cool.
- Pure crystals of *kewu* will be formed (recrystallised) in the solution.
- FILTER the resulting solution to get the pure *kewu* salt crystals using a pre- weighed filter paper
- Leave the pure crystals to dry
- Weigh the crystal and filter paper and calculate the percentage yield using the formula below

$$\text{percentage yield} = \frac{X}{Y} \times 100\%$$

Where X = mass of pure *kewu* salt; Y = mass of impure *kewu* salt

Reflection on the experiment

What would you do when crystals do not form after reducing the volume of the solution to half?

Think about how to separate a mixture of sand and common salt.

C. Assessment – Student's sheet

On completion of the experiment, you should answer the following questions:

1. What physical property of the *kewu* mixture enabled you to separate the two components? (KN2)

2. List, in order, the stages of the process of purifying the *kewu* salt (one word for each stage). (KN1)

3. How would you separate a mixture of charcoal and ammonium chloride? (CS1)

4. If an initial mixture of sand and salt weighed [or had a mass of] 56.7 g and the purified salt had a mass of 17.3 g, what percentage of the mixture was salt? (KS1)

5. If an initial mixture of *kewu* weighed [or had a mass of] 83.1 g and the dirt in the filter paper had a mass of 34.5 g, what percentage of the mixture was salt? (KS1)

6. What is the essence of crushing of the 'kewu'?

D. Extensions to experiment

Design an experiment on how you would separate each of the following mixtures.

- i. Common salt and sand
- ii. Naphthalene and sand

E. Useful links

<http://www.gcsescience.com/el.htm>

<http://dbhs.wvusd.k12.ca.us/>

F. Health and Safety

BASIC SAFETY RULES:

- a. Do not eat, drink or chew whilst doing the experiment.
- b. Keep your face at a safe distance from open flames and heated solutions. Never look into a heated solution from above.
- c. Avoid breathing in dust or vapour. When smelling solutions, gently wave the air above the solution towards your nose with your hand.
- d. Wash any spilled solutions from your skin with plenty of water, and notify the instructor.
- e. Report any accident, no matter how minor, to the instructor/report the nearest health post.

Compulsory rules

You will not be allowed to do the experiment unless you are wearing the following items:

- a. Long-sleeved overcoat that is long enough to cover the hips, worn closed at all times.
- b. Safety glasses. Please note that contact lenses do not provide eye protection and in some cases may complicate an emergency (caustic liquids which splash into the eye can be trapped behind the contact lens). You are advised to avoid wearing contact lenses in the laboratory, if possible.
- c. Closed, flat-heeled shoes (no open sandals).
- d. Long hair and loose scarves must be tucked away or tied up.
- e. Wear protective gloves when using toxic or corrosive chemicals.

Tidy working

Keep your working area tidy. A cluttered bench is a common contributory factor to accidents. Cleaning the glassware after use should be done immediately. This prevents the organic tarry material from attacking the surface of the glass.

Always clean up a chemical spill without delay.

Clean up and dispose of your unknown substances according to your teacher's instructions.

G. Evaluation

- a. What methods could be used to determine the purity of the *kewu* pure crystals?
- b. Was it difficult or easy to have access to the experimental materials listed?
- c. Were the experimental procedures easy to follow? Explain
- d. Suggest other methods and materials which can be included in this pack