Precipitation reactions

Posted by Anonymous on Mon, 2019-06-24 14:33

Precipitation reactions: I am looking for precipitate reactions that have the least impact on the environment but are also dramatic. Do you have any suggestions?

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8
9
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Laboratory Technicians:

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precipitation reactions

Submitted by sat on 24 June 2019

Answer reviewed 17 February 2023

Have you considered conducting precipitate reactions using microscale techniques? The use of micro quantities of chemicals can enable the demonstration of many chemistry principles with no compromise of outcomes and with minimal impact on the environment.

Micro scale chemistry

Micro scale chemistry is the scaling down in size of practical chemistry by using smaller quantities or volumes of chemicals. This can be done using spotting plates, multi-well (culture) plates, laminated grid sheets, or smaller test tubes.

A simple way to demonstrate precipitation reactions is to use a laminated A4 page with a grid printed on it, or to place a page with a grid printed on it inside a plastic sleeve. One drop of two different, dilute (0.1M) solutions can be added together and observed for the formation of a precipitate. The results can be observed in a table form for comparison, whilst using small quantities of the solutions and producing very little waste. The chemical waste for these activities in drops of water is not significant and can be wiped up with a paper towel or tissue and disposed of in the general waste. This assumes safe chemical handling, good laboratory practices and in particular, ensuring that hands are washed at the end of the laboratory session.

Micro scale chemistry has the benefits of quicker reaction times and:

- Reduced materials
- Reduced costs
- Reduced risk - there is less contact with hazardous chemicals
- Reduced chemical waste
- Reduced preparation and clean-up time
- Reduced reliance on traditional glassware.
- Reduced storage requirements.

For further information on microscale chemistry see https://assist.asta.edu.au/question/4483/microscale-chemistry 1

Links to websites for precipitation reaction examples

Royal Society of Chemistry,

Micro scale reactions of positive ions with sodium hydroxide. 2

Observing chemical changes3

YouTube videos by Bob Worley, a CLEAPSS advisor.

Bob Worley has a number of YouTube videos showing very dramatic reactions in a drop of water. The method used, demonstrates **dissolving**; **diffusion** and then **precipitation**. For example:

- **'Lead iodide precipitate'**, YouTube (1:13 min) https://youtu.be/tIkzoPzsaNU. This reaction is quite spectacular with the formation of the distinct yellow precipitate as a line. Note: this activity uses solid chemical and should be conducted as a demonstration and projected onto a screen (e.g. using a document camera) or showing this YouTube video. See safety notes for using lead nitrate below.
- **'Iron thiocyanate complex no magnet'**, YouTube (0:38 min) https://youtu.be/jo4Kz8-FqVo . This reaction is quite spectacular with the formation of a distinct red iron thiocyanate complex as a line.
- **'Iron thiocyanate complex with magnet'**, YouTube (1:16 min) https://youtu.be/mS1o9Dn7nRM . This is an extension of the iron thiocyanate complex with distortion of the 'line' due to the magnetic effect.
- **'Iron (III) nitrate with sodium hydroxide'**, YouTube (1:48 min) https://youtu.be/tG6_KBg4nZs . This is extremely visual due to the addition of a bromothymol blue indicator and the formation of a distinct brown precipitate.

‘Four ways to do a microscale precipitation reaction’

For details on this method, see ‘Precipitates’, YouTube (1:17 min) https://youtu.be/9zYcE35_Vsw4

1. Add one drop of a chemical solution on an acetate sheet and then on top of this drop, add one drop of a different chemical solution and observe if a precipitate forms.
2. Add one drop each of two different chemical solutions, side by side on an acetate sheet and then mix the two drops together and observe if a precipitate forms.
3. Add two drops of distilled water side by side on an acetate sheet and then add a tiny amount of two different solid chemicals to each drop. Mix each drop and then combine the two drops
4. Add one drop of distilled water on an acetate sheet. Using fine pop sticks (The thin coffee type sticks or toothpicks) push a tiny amount of solid chemical into opposite sides of the drop, then wait, after a short time, you should see a line appear, where the two solutions ‘collide’ and form a line where a precipitate has formed

The 4th and last method clearly demonstrates **dissolving**; **diffusion** and then **precipitation**.

An alternate way to place the solid chemicals into the one drop of distilled water for these precipitation activities is to:

- Dampen the ends of pointed wooden splints or two toothpick/cocktail sticks and hold them in each hand.
- Dip the damp sticks into each solid provided so that there is a little attached to the stick.
- Insert the sticks into the opposite ends of the drop so that the solids come off and dissolve.
- This could be organised as different stations for different precipitates around the room to minimise the setup of solid chemicals

Other examples of microscale chemistry in a drop

- A diffusing neutralisation in a drop of distilled water with a drop of universal indicator see ‘Diffusing neutralization x4 Copy’, YouTube (1:04 min) https://youtu.be/_GIXMUsCPXA
- A microscale reaction for metal displacement observing silver nitrate reacting with copper wire see ‘Silver nitrate reacting with copper wire’, YouTube (0.20 sec) https://youtu.be/bj1Bjh0VbvU

We suggest that you trial this using 1-2 drops of 0.1M silver nitrate on an acetate sheet/plastic sleeve protector and place a bare (not coated) copper wire half-way into the droplet. This could even be filmed using a mobile phone with a magnifying lens added.

The chemical waste for these activities in drops of water is not significant and can be wiped up with a paper towel or tissue and disposed of in the general waste. This assumes safe chemical handling, good laboratory practices and in particular ensuring that hands are washed at the end of the laboratory session.

Safety notes for using lead nitrate

When Science ASSIST did a comparison between different jurisdictions, lead metal was permitted in all jurisdictions although it was noted as being a high risk substance in Queensland.5There was variation between jurisdictions regarding the use of lead salts, from being approved, restricted to year 11 and 12 through to being banned.

Science ASSIST considers that although there are health hazards associated with lead, by implementing appropriate controls such as restricting the number of lead-containing substances used in science and ensuring safe handling procedures, the risks can be safely managed within the school setting. Only solutions 0.1M or lower are recommended for use by year 7-12 students.6 Small quantities should be used for short amounts of time, wearing appropriate PPE such as gloves and safety glasses. Good laboratory hygiene such as cleaning up any spills, no eating or drinking in laboratories and washing hands at the end of all laboratory sessions should also be implemented.

References:

1Science ASSIST. 2023. *Microscale chemistry Q&A*, Retrieved from the Science ASSIST website, https://assist.asta.edu.au/question/4483/microscale-chemistry

2 Royal Society of Chemistry, (nd) '*Micro scale reactions of positive ions with sodium hydroxide'* Retrieved (17 February 2023) from the Royal Society of Chemistry website: https://edu.rsc.org/experiments/microscale-reactions-of-positive-ions-with-sodium-hydroxide/757.article

3 Royal Society of Chemistry, (nd) '*Observing chemical changes, teaching notes and expected observations'* Retrieved (17 February 2023) from the Royal Society of Chemistry website: https://edu.rsc.org/experiments/observing-chemical-changes/508.article

4 Worley, B. (2018, Apr 19), *Precipitates- Four ways to do a microscale precipitation reaction*, YouTube video: https://youtu.be/9zYcE35_Vsw

5 Queensland Government Department of Education, (2022, March 29), Chemical management procedure, Retrieved from the Queensland Government Department of Education website: https://ppr.qed.qld.gov.au/pp/chemical-management-procedure (scroll down and click on 'Prohibited chemicals')

6 Science ASSIST. 2017. *List of recommended chemicals for science in Australian schools*, 'Notes' Tab, note C, Science ASSIST website, https://assist.asta.edu.au/resource/3052/list-recommended-chemicals-science-australian-schools

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