Esters – preparation, properties and disposal

Posted by Anonymous on Fri, 2015-03-27 09:57

Esters – preparation, properties and disposal

This is a combination of several questions

- I have previously been asked to dispose of the chemical waste from the ester prac by evaporating it on an absorbent material and disposing of this to landfill. I have now been asked to store the waste in an organic waste bottle for collection at a later date. I have begun decanting this waste into a large glass bottle. However, when I opened the bottle, there was a large rush of gas from the bottle. Is this normal? It did concern me somewhat and I was pleased I had opened it in the fume cupboard. My question is: what is the correct way to dispose of this waste?
- Chemical waste disposal – from esterification activity: I would like to know how the waste generated from the Isopentyl acetate esterification process should be disposed of?
- I have a fair bit of waste collected. Is there any way I can reduce and dispose or may be use it for some other purpose?
- Could someone please advise about the safe storage and disposal of esters?

Voting:
No votes yet

Year Level:
7
8
9
10
Senior Secondary
Laboratory Technicians:
Laboratory Technicians

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Chemical Waste from Ester Prac

Submitted by sat on 16 April 2015

Answer reviewed 3 November 2022

Preparation and Properties of Esters

In schools, ester preparation often involves mixing a few drops of an alcohol and a similar amount of a carboxylic acid in a test tube, along with an acid catalyst such as concentrated sulphuric acid, and then heating the mixture in a water bath. The odour of the ester may then be observed by wafting fumes from the test tube or by pouring the mixture onto a small amount of water in a beaker and observing the odour from the ester layer which forms on top of the water.

On a larger scale, after heating the reaction mixture and allowing it to cool, the mixture may then be transferred to a separating funnel and washed with sodium carbonate solution to remove the acid catalyst as well as any unreacted carboxylic acid.

In school ester preparation activities, depending on the length of the carbon chain, the esters produced may be categorised as highly flammable, flammable or combustible. The alcohols used are also flammable and many are irritating to the skin and respiratory system. While esters often have a sweet fruity aroma, the component acids and alcohols can smell very unpleasant. Esters vary in their miscibility with water according to their chain length and structure.

Disposal of Esters

The best practice for disposing of organic waste is to transfer it to an appropriately labelled bottle for collection by a licenced waste disposal contractor. If the esters are prepared in test tubes, and not washed or added to water, then the entire contents of the test tubes should be transferred to a non-halogenated organic waste bottle and stored for collection. Use small volumes in mini test tubes to reduce the amount of waste produced.

If the ester is washed with water or carbonate solution, then the composition of the aqueous layer would depend on the miscibility of the reagents used and ester(s) produced in the activity. Separation of the layers can be achieved using a separation funnel. The funnel should be large enough that the volume of the liquid waste is not more than 2/3 of the volume of the funnel (alternatively, the separation can be carried out in batches). The top layer will be the organic layer and the lower layer, the aqueous layer. Best practice would be to store the organic layer in a separate bottle to the aqueous layer. However, if the layers were difficult to separate, then it would be reasonable to transfer both layers to the same waste bottle.

The concentration of organic compounds in the aqueous layer would exceed the accepted limits in most jurisdictions. Therefore, we recommend that the aqueous layer be transferred to a separate waste bottle labelled as ‘Dilute aqueous waste’ and also stored for collection via a licenced waste disposal contractor. Research into the trade waste acceptance standards in all of the Australian states and territories and direct consultation with five water authorities has found that In general, the accepted concentrations for organic compounds are very low (e.g., from 1mg/L to 30 mg/L for saturated hydrocarbons). Flammable substances are specifically prohibited from being discharged to the sewerage system, as are water-immiscible liquids.

In WA and NSW, small amounts of water-miscible organic substances from science laboratories may be discharged down the sink as long as there is appropriate dilution. In these states, any aqueous layers produced in ester preparation activities could be neutralised and then washed down the sink with copious amounts of water. While it is not prohibited in Australia to evaporate volatile waste in a fume cupboard, it is not considered best practice, as this introduces untreated waste into the atmosphere (this method of waste disposal is prohibited in the U.S.A.).

Glassware contaminated with any of the organic compounds used or produced can be rinsed with a small amount of ethanol with the rinse liquid being added to the organic waste bottle. If any gas is produced from the stored mixture, it is likely to be carbon dioxide produced from the reaction of the sodium carbonate and the acid catalyst or unreacted carboxylic acid.

It is good practice to keep track of the substances that are added to a waste bottle. One way to do this is to attach a blank label onto the back of the waste bottle. Each time waste is added to the bottle, the names of the substances added can be recorded on the label. When the bottle is full, then the hand-written label can be replaced with a printed label containing this information.

Alternative Activity

Some schools use gourmet jellybeans to experience the aroma of esters; see the esters experiment alternative, See 'Esters – A tasty investigation' http://www.labnetwest.asn.au/experiments/. Do remember to use a non-science room for all activities where foods are consumed.

References

Nuffield Foundation and The Royal Society of Chemistry (2016) '*Making Esters from Alcohols and Acids'* https://edu.rsc.org/experiments/making-esters-from-alcohols-and-acids/1743.article

Armour, M-A., Ashick, D., Konrad, J. 1999. 'Tested methods for the handling of small-scale spills', Chemical Health and Safety, 6: 24-27

LABNETWEST (2016), '*Esters – A Tasty Investigation'* http://www.labnetwest.asn.au/esters-experiment-alternative/

Science ASSIST. (2018). *Chemical Management Handbook for Australian Schools – Edition 3*, Retrieved from the Science ASSIST website: https://assist.asta.edu.au/resource/4193/chemical-management-handbook-australian-schools-edition-3

Links to some information specific to states and territories water authorities

Note: Some states have multiple water authorities responsible for trade waste. Ensure that you are looking at the correct authority for your region.

ACT: 'Liquid trade waste', icon water website https://www.iconwater.com.au/Developers-and-Renovators/LiquidTradeWaste (Accessed 22/09/2022)

NSW: 'Liquid trade waste', NSW Department of Planning, Industry and Environment website, https://www.industry.nsw.gov.au/water/water-utilities/regulatory-assessments/liquid-trade-waste (Accessed 22/09/2022)

NT: ‘Trade Waste’, Power and Water Corporation website, https://www.powerwater.com.au/developers/water-development/trade-waste (Accessed 22/09/2022)

Qld: ‘Trade waste’, Urban Utilities website, https://www.urbanutilities.com.au/business/business-services/trade-waste (Accessed 22/09/2022)

Qld: Trade Waste Guidelines: City of Gold Coast website, https://www.goldcoast.qld.gov.au/Services/Water-sewerage/Sewage-recycled-water/Trade-waste (Accessed 22/09/2022)

SA: ‘Trade waste management’, SA Water website, https://www.sawater.com.au/my-business/trade-waste/trade-waste-management (Accessed 22/09/2022)

Tasmania: ’Trade Waste and your business’, TasWater website, https://www.taswater.com.au/customers/businesses/trade-waste (Accessed 22/09/2022)

Victoria: ‘Trade waste agreements in Victoria’, CleanaWater website, https://cleanawater.com.au/information-centre/trade-waste-agreements-in-victoria (Accessed 22/09/2022)

Victoria: ‘Trade waste’ Barwon Region Water Corporation, https://www.barwonwater.vic.gov.au/water-and-waste/trade-waste (Accessed 22/09/2022)

Victoria: ‘Trade Waste’ City West Water website, https://www.gww.com.au/business/trade_waste (Accessed 22/09/2022)

Victoria: ‘Trade Waste’, Goulburn Valley Water website https://www.gvwater.vic.gov.au/business/trade-waste (Accessed 22/09/2022)

Victoria: ‘Commercial trade waste’, Gippsland Water website, https://www.gippswater.com.au/water-and-waste/commercial/commercial-trade-waste (Accessed 22/09/2022)

Victoria: ‘Manage trade waste’, South East Water Corporation website, https://southeastwater.com.au/water-waste-and-environment/trade-waste/ (Accessed 22/09/2022)

Victoria: ‘Trade Waste’ Yarra Valley Water website, https://www.yvw.com.au/help-advice/trade-waste (Accessed 22/09/2022)

WA: ‘Trade waste’, Water Corporation website, https://www.watercorporation.com.au/Help-and-advice/Trade-waste/
