LAB WORK 11 EXTRACTION AND SEPARATION

Pharmaceutical industry uses chemical synthesis processes to produce the majority of drugs on the market today. Typically, a series of chemical reactions are performed in reactors and the synthesized drugs are isolated from the reaction mixture by extraction, crystallization and filtration. The method used to separate one substance from another depends on the physical properties of the substances involved. In this lab, two separation techniques will be investigated.

Safety information:

Chemical	Hazard symbol	Safety advices
cyclohexane	 Xn - Harmful  N - Dangerous for the environment  F - Flammable Severe eye irritant	Avoid contact with eyes. Keep container in a well-ventilated place. Keep away from source of ignition. Take precautionary measures against static discharges. This material and its container must be disposed of as hazardous waste. Avoid release to the environment.
copper sulfate	 Xn - Harmful  N - Dangerous for the environment  Xi - Irritant	Do not breathe dust. This material and its container must be disposed of as hazardous waste. Avoid release to the environment.
diiodine	 Xn - Harmful  N - Dangerous for the environment	Avoid contact with eyes. Do not breathe gas/fumes/vapour/spray. Avoid release to the environment.

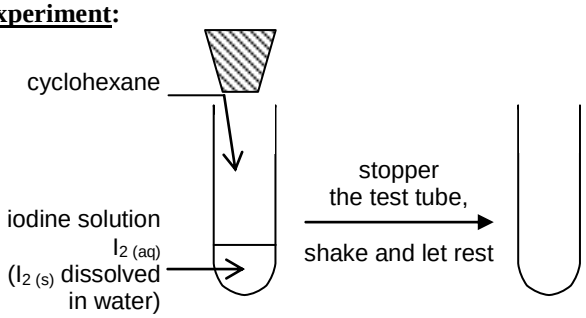
1. Solvent extraction

1.1. Extraction

Water and cyclohexane are colourless solvents.

1. What is the solvent and what is the solute in an aqueous solution of diiodine $I_{2\,(aq)}$?
2. What is the colour of diiodine dissolved in water?

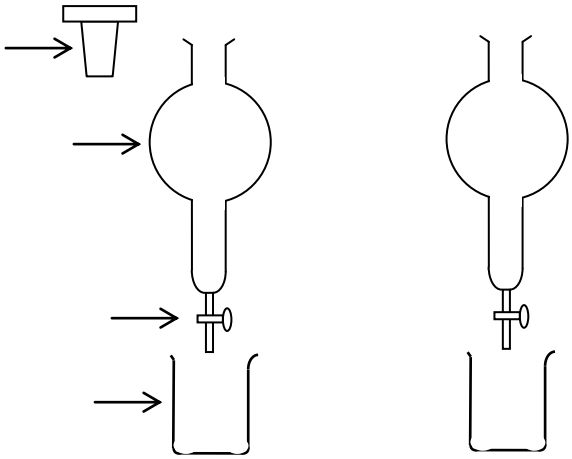
Experiment:



3. How many phases do you observe?
   What can you conclude about water and cyclohexane?
4. Add one drop of water, observe where it goes. Where is the aqueous phase?
   Which solvent is denser?
5. Is diiodine still dissolved in water?
   What is the colour of diiodine dissolved in cyclohexane?
6. In which solvent is diiodine more soluble?

1.2. Separation

- Pour the mixture in a separating funnel (tap closed!)
- Transfer the lower phase to a beaker.
- Annotate the diagram and draw the two phases *before* and *after* the separation.
- Pour the phase containing diiodine in the appropriate waste can.
- Can you throw the other phase in the sink?

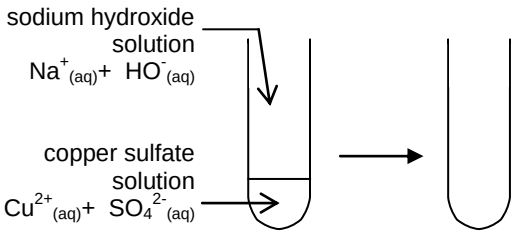


1.3. Conclusion

Solvent extraction (also called liquid-liquid extraction) : a …… is transferred from its original …… to an immiscible …… (called extraction ……) in which the …… is more …… .

2. ……

1.1. Precipitation



1. Which ions make the copper sulfate solution blue?
2. What do you observe when you pour sodium hydroxide solution?
3. The ions that do not react are called 'spectator ions'. The spectator ions here are $Na^+_{(aq)}$ and $SO_4^{2-}_{(aq)}$. Which are the reacting ions?
4. Write a balanced equation (with state symbols (g) (ℓ) (s) (aq)) for the reaction, knowing that the equation omits the spectator ions.
5. If enough sodium hydroxide is poured, will there still be some Cu^{2+} ions dissolved in water?

1.2. Separation

1. How could you separate the solid phase from the liquid phase?
2. Draw and label a diagram of the apparatus.
3. Write the title of part 2.

3. Extraction and separation of two pollutants

During a labwork, a diiodine solution and a copper sulfate solution have been accidentally mixed. The mixture is a green aqueous solution.

1. Why is the mixture green?
2. Observe the pictures shown by the teacher and complete the following table:

	Solubility in water	Solubility in cyclohexane
copper sulfate		
diiodine		

3. Imagine a procedure to extract the diiodine from the solution and then the copper ions.
4. Carry out the extractions.
5. Draw and label a diagram of the experiment.
6. What is the colour of the solution after both extractions? Is it pure water?
7. What do you think about the method used here to extract diiodine (see *Safety information*)