DISTILLATION : PURIFICATION OF A MIXTURE OF MISCIBLE LIQUIDS

EXPERIMENTAL TECHNIQUES REQUIRED

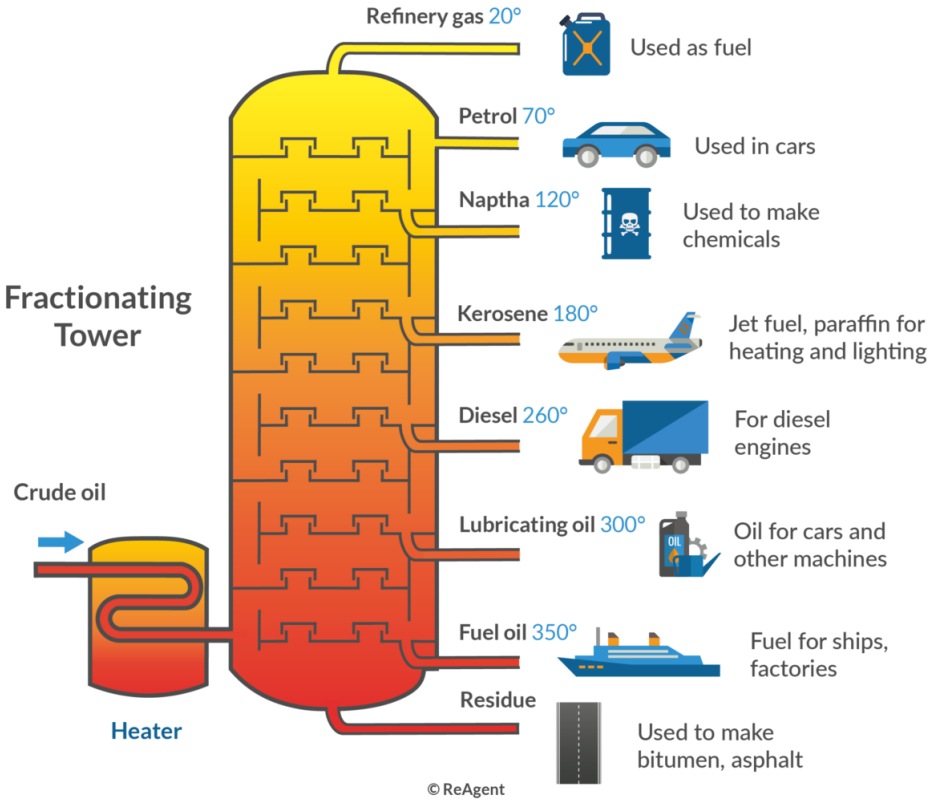
Fractional distillation (T 10), greasing glass joints (T 11), gas chromatography (T 13)

OTHER DOCUMENTS

Experimental procedure, report template (Word, 4 page), gas chromatography traces

INTRODUCTION

Distillation is used separate mixtures of miscible liquids based on the differences of the boiling points of the components. Simple distillation can be used when there is a larger difference in boiling point. Fractional distillation can be used for more complex mixtures with closer boiling points. The technique is also versatile and can be used from the microscale (mg scale) to the macroscale (tonnes). Distillation is used to purify mixtures of fluids (*e.g.* crude oil purification : for the separation of the components of crude oil into various more useful fractions, fractionation of air to obtain nitrogen, oxygen and argon gases), to remove liquids from mixtures or materials (*e.g.* distillation of alcoholic beverages). In the chemistry laboratory it can be used to help isolate and / or purify the product of a reaction or to help drive equilibrium reactions to completion (via Le Chatelier's principle) by the removal of a volatile (*i.e.* low boiling) component.



Schematic Diagram for the Fractional Distillation of Crude Oil and the "fractions" [1]

Fractional Distillation of an Unknown Mixture

You will be provided with an unknown mixture of two solvents from the table provided on the next page. The solvents are mutually soluble (*i.e.* they are miscible) and differ in boiling point by more than 15°C. You are required to separate the two solvents by fractional distillation, monitoring the temperature at the distillation head (make sure you set your thermometer position correctly) and recording the volume of distillate collected as the experiment proceeds. It is easiest to use a graduated cylinder as a receiver instead of a flask. With the aid of a couple of simple solubility tests and density measurements of your fractions, you should then be able to identify the component solvents. You will also be required to report the composition of your mixture (*e.g.* 50% solvent A, 50% solvent B) and analyse the efficiency of your distillation based on your interpretation the graphical plot of your measurements.

Some Properties of Common Solvents

Solvent	Boiling Point (760 mm)°C	Density (20°C) g/mL	Solubility in Water
acetone	56.5°	0.7899	∞
chloroform	61.7°	1.4832	δ
methanol	64.7°	0.7914	∞
hexane	68°	0.6603	i
1,1,1-trichloroethane	74°	1.339	i
carbon tetrachloride	77°	1.5940	i
ethanol	78.0°	0.785	∞
cyclohexane	81°	0.779	i
2-methyl-2-propanol	82.2° [25.5]*	0.7887	s
trichloroethylene	87°	1.4642	δ
water	100°	1.0	-
toluene	110.6°	0.8669	i
1-butanol	117.2°	0.8098	δ
tetrachloroethylene	121°	1.6227	i
octane	125-6°	0.703	i

* - m.p. ∞ - infinitely soluble i - insoluble s - soluble δ - sparingly soluble

REFERENCES

1. What is Fractional Distillation? - The Chemistry Blog (Feb 26 2025)
https://www.chemicals.co.uk/blog/what-is-fractional-distillation