Name of the project:	**Digitization of chemistry experiments to improve the quality and support chemistry teaching in secondary schools**
Acronym:	**ChemIQSoc**
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Tittle: Preparation of Mohr's salt

Work instructions

Task: Prepare Mohr's salt by reacting ferrous sulfate heptahydrate with ammonium sulfate.

Theory

Ferrous sulfate heptahydrate forms light green to green-blue crystals (monoclinic lattice), where Fe^{2+} is much more stable to oxidation by air oxygen than Fe^{2+} in ferrous sulfate.

It is because of its relative stability that Mohr's salt is used as a standard in manganometry. It loses crystal water when heated above 100°C, and separates ammonia at 170°C. At normal temperature the salt can be stored without change.

Reaction of ammonium sulfate with ferrous sulfate heptahydrate:

$$\mathbf{FeSO_4 \cdot 7H_2O + (NH_4)_2SO_4 \rightarrow (NH_4)_2Fe(SO_4)_2 \cdot 6H_2O + H_2O} \quad (1)$$

Equipment: beakers, scales, spoon, funnel, filter paper, ring stand, glass rod, crystallisation dish, Büchner funnel, suction flask, water jet pump, watch glass

Chemicals: ferrous sulfate heptahydrate, sulfuric acid (96%), iron nail, ammonium sulfate

Procedures:

1. Weigh 25 g of ferrous sulfate heptahydrate into a 100-150 ml beaker and dissolve in the necessary quantity of water, acidified with a few drops of sulfuric acid, to make a saturated solution at 20°C.
2. Then insert a small iron nail into the solution. (The above precaution is necessary to prevent hydrolysis and rapid oxidation of the ferric salt.)
3. Dissolve the calculated amount of ammonium sulfate in the second beaker to give a saturated solution at 20°C.
4. Heat both solutions to 50-60°C, filter and mix in a crystallisation dish. Part of the product may be excluded by cooling the mixture, but most of the product will crystallise by free evaporation of the solvent.
5. Filter the product through a frit or Büchner funnel. Cool with ice water, aspirate and dry between filter paper. Dry freely in the air.

Management of chemical substances

Chemicals	Form	H-statements	P-statements
$(NH_4)_2Fe(SO_4)_2 \cdot 6H_2O$	Solid	H315, H319, H335	P261, P305 + P351 + P338
$(NH_4)_2SO_4$	Solid	H319, H335, H315	P280, P305 + P351 + P338
$FeSO_4 \cdot 7H_2O$	Solid	H302, H315, H319	P280, P302 + P352, P305 + P351 + P338
H_2SO_4	Liquid, 96%	H314	P280, P301 + P330 + P331, P305 + P351 + P338, P310

Sources of risk and assessment of risk severity

Ferrous sulfate and ammonium sulfate are irritants if ingested and are an acceptable risk if the substance comes into contact with the eye or mucous membranes, i.e. if protective equipment is used. The substances are safe to work with the use of protective equipment and supervision by the teacher. The teacher's instructions should therefore be followed strictly.

Waste management method

Transfer all the product into the bottle prepared by the teacher. No other waste should be produced during this work.

Risk reduction measures

Wear tight-fitting safety glasses or face shield, rubber gloves protective clothing and footwear. Wash hands thoroughly after handling. If skin contact occurs, wash with plenty of warm water and soap. In the event of an accident or if you feel unwell, inform the teacher immediately. Do not eat, drink, or smoke while working. Follow the safety instructions given by the teacher. If eyes are hit, rinse gently with water for a few minutes. Remove contact lenses, if fitted, and if they can be removed easily. Continue rinsing. Avoid release into the environment.

Worksheet

Calculations

1. For the preparation of Mohr's salt, use 25 g of ferrous sulphate heptahydrate. Calculate:
   a. the volume of water required to prepare the saturated ferrous sulphate solution at temperature 20°C
   b. weight of ammonium sulphate
   c. the volume of water required to prepare the saturated ammonium sulphate solution at temperature 20°C
   d. the weight of Mohr's salt

Equation: $FeSO_4 \cdot 7H_2O + (NH_4)_2SO_4 \rightarrow (NH_4)_2Fe(SO_4)_2 \cdot 6H_2O + H_2O$

$M(FeSO_4 \cdot 7H_2O)$ = ... $g.mol^{-1}$, $M((NH_4)_2SO_4)$ = ... $g.mol^{-1}$,

$M((NH_4)_2Fe(SO_4)_2 \cdot 6H_2O)$ = ... $g.mol^{-1}$, $\rho(H_2O, 20°C)$ = ... $g.cm^{-3}$

$s(FeSO_4, 20°C)$ = ... g compound/100 g solution, $s((NH_4)_2SO_4)$ = ... g compound/100 g solution

Volume of water required for the preparation of saturated ferrous sulphate solution at temperature 20°C

Weight of ammonium sulphate

Volume of water required for the preparation of saturated ammonium sulphate solution at temperature 20°C

Mohr's salt weight (theoretical yield)

2. Calculate the practical yield of Mohr's salt in %.
   PV = ... g, TV = ... g

   PV(%) = ... %

Observation

1. Describe the appearance of Mohr's salt.

2. Search for the basic physicochemical properties of Mohr's salt.

Feature	**Value**
Solubility in water	
Solubility in other solvents	
Melting point	

Yield

1. Record the mass of the prepared Mohr's salt.

   m($(NH_4)_2Fe(SO_4)_2 \cdot 6H_2O$) = ... g

Questions

1. Write the equation of the reaction for the preparation of Mohr's salt.

2. Explain why ferrous sulphate heptahydrate dissolved in water acidified with a few drops of sulphuric acid.

3. Explain why you filter Mohr's salt through a Büchner funnel and not through a filter funnel with folded filter paper.

4. Indicate how you crystallized Mohr's salt, by disturbed or free crystallization.

5. Describe the use of Mohr's salt.

Conclusion

Briefly summarize the objective of the experiment, the main results and compare them with the expected values.

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