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## Aim

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To prepare a sample of cuprammonium rayon threads from filter paper.

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## Apparatus Required

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- a) Conical flask (preferably 250 ml)
- b) Funnel
- c) Glass rod
- d) Beaker (preferably 250 ml)
- e) Water bath
- f) Filter paper (Whatman paper or ordinary filter paper sheets.  
Preferably, Whatman)

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## Chemicals Required

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- a)  $\text{CuSO}_4$
- b) NaOH solution
- c) Liquor ammonia solution
- d) Dilute  $\text{H}_2\text{SO}_4$
- e) Whatman Paper
- f) Distilled  $\text{H}_2\text{O}$

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## Background

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Rayon is a synthetic fiber produced from cellulose. Developed in an attempt to produce silk chemically, it was originally called artificial silk or wood silk. Rayon is a regenerated fiber, because cellulose is converted to a liquid compound and then back to cellulose in the form of fiber. For example, cuprammonium rayon is made by dissolving cellulose in an ammoniacal copper sulphate solution.

The characteristics of rayon fibers are:

- ❖ They are highly absorbent,
- ❖ Soft and comfortable,
- ❖ Easy to dye &
- ❖ Drape well.

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## Introduction

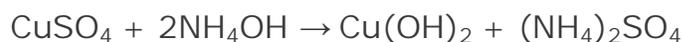
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Cellulose is nature's own giant molecule. It is the fibrous material that every plant from seaweed to the sequoia makes by baking glucose molecules in long chains; the chains are bound together in the fibers that give plants their shape and strength. Wood has now become the main source of cellulose. Since it contains only 40% to 50% cellulose, the substance must be extracted by 'pulping'. The logs are flaked, and then simmered in chemicals that dissolve the tarry lignin, resins and minerals. The remaining pulp, about 93% cellulose, is dried and rolled into sheets-raw material for paper, rayon and other products.

It can be obtained in 2 ways:

1. Viscose Process: Cellulose is soaked in 30% caustic soda solution for about 3 hrs. The alkali solution is removed and the product is treated with  $\text{CS}_2$ . This gives cellulose xanthate, which is dissolved in NaOH solution to give viscous solution. This is filtered and forced through a spinneret into a dilute  $\text{H}_2\text{SO}_4$  solution, both of which harden the gum-like thread into rayon fibers. The process of making viscose was discovered by C.F.Cross and E.J.Bevan in 1891.
2. Cuprammonium Rayon: Cuprammonium rayon is obtained by dissolving pieces of filter paper in a deep blue solution containing tetra-ammine cupric hydroxide. The latter is obtained from a solution of copper sulphate. To it,  $\text{NH}_4\text{OH}$  solution is added to precipitate cupric hydroxide, which is then dissolved in excess of  $\text{NH}_3$ .

### Reactions:



Pale blue ppt



$[\text{Cu}(\text{NH}_3)_4](\text{OH})_2$  + pieces of filter paper left for 10-15 days give a viscous solution called VISCOSE.

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## Procedure

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### A. Preparation of Schweitzer's Solution:

- a) Weigh 20g of  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ .
- b) Transfer this to a beaker having 100ml distilled water and add 15ml of dilute  $\text{H}_2\text{SO}_4$  to prevent hydrolysis of  $\text{CuSO}_4$ .
- c) Stir it with a glass rod till a clear solution is obtained. Add 11ml of liquor ammonia drop by drop with slow stirring. The precipitate of cupric hydroxide is separated out.
- d) Filter the solution containing cupric hydroxide through a funnel with filter paper.
- e) Wash the precipitate of cupric hydroxide with water until the filtrate fails to give a positive test for sulphate ions with barium chloride solution.
- f) Transfer the precipitate to a beaker that contains 50ml of liquor ammonia or wash it down the funnel. The precipitate when dissolved in liquor ammonia gives a deep blue solution of tetra-ammine cupric hydroxide. This is known as SCHWEITZER'S SOLUTION.

### B. Preparation of Cellulose material

- a) After weighing 2g of filter paper divide it into very fine pieces and then transfer these pieces to the tetra-ammine cupric hydroxide solution in the beaker.
- b) Seal the flask and keep for 10 to 15 days, during this period the filter paper is dissolved completely.

### C. Formation of Rayon Thread

- a) Take 50ml of distilled water in a glass container. To this add 20ml of conc  $\text{H}_2\text{SO}_4$  drop by drop. Cool the solution under tap water. In a big glass container pour some of the solution.
- b) Fill the syringe with cellulose solution prepared before.

- c) Place the big glass container containing  $\text{H}_2\text{SO}_4$  solution produced before in ice (the reaction being spontaneous results in excess release of energy in the form of heat which makes the fibers weak and breaks them).
- d) Immerse the tip of the syringe in the solution and press gently. Notice the fibers getting formed in the acid bath. Continue to move your hand and keep pressing the syringe to extrude more fibers into the bath.
- e) Leave the fibers in solution till they decolorize and become strong enough.
- f) Filter and wash with distilled water.

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## Precautions

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- a) Addition of excess  $\text{NH}_3$  should be avoided.
- b) Before taking the viscose in the syringe make sure that it does not contain any particles of paper, otherwise, it would clog the needle of the syringe.
- c) Addition of  $\text{NH}_3$  should be done in a fume cupboard and with extreme care. The fumes if inhaled may cause giddiness.
- d) Use a thick needle otherwise the fibers won't come out.

# Bibliography

- Chemistry (Part I) – Textbook for Class XII; National Council of Educational Research and Training
- Concepts of Physics 2 by H C Verma; Bharti Bhawan (Publishers & Distributors)

Websites :

- ✓ <http://www.cbseportal.com>