# How was mauve made?

## A brief history of mauve

Until the 1850s, cloth was dyed using plant materials. There was a huge industry related to this, involving growing the plants, importing plant materials, extracting the dye and dying the cloth. The dyes were not marvellous – the colours were quite dull and often faded in light and with repeated washing.

In 1856, aged 18, William Perkin was carrying out experiments aiming to make quinine, a cure for malaria. Malaria was raging through Europe and in parts of the UK. Finding a cure would have made the inventor very rich. Instead, Perkin accidentally made a bright purple substance that dyed silk permanently. He patented the process and persuaded his father to invest the family savings in setting up a dye factory in Greenford, West London. Some French chemists had also made a purple dye at about the same time, but using a different process. Luckily for Perkin, Empress Eugenie, the wife of Emperor Napoleon III of France, who was a beautiful, fabulous fashion icon, decided purple matched the colour of her eyes, so had dresses made in purple silk. Within five years, Perkin had earned a fortune, as purple became the most fashionable colour in Victorian Britain. The discovery revolutionised the dyeing industry forever.

Read the two accounts describing how to make mauve, then do the tasks that follow.

## Perkin's patent of 1856

This is how Perkin described the process for making mauve in his patent:

*I take a cold solution of sulphate of aniline, or a cold solution of sulphate of toluidine or a cold solution of xylidine, or a mixture of any one of such solutions with any others of other of them, and as much of a cold solution of a soluble bichromate as contains base enough to convert the sulphuric acid in any of the above-mentioned solutions into a neutral sulphate. I then mix the solutions and allow them to stand for ten or twelve hours, when the mixture will consist of a black powder and a solution of a neutral sulphate. I then throw this mixture upon a fine filter and wash it with water till free from the neutral sulphate. I then dry the substance thus obtained at a temperature of 100 degrees centigrade, or 212 degrees Fahrenheit and digest it repeatedly with coal-tar naphtha until it is free from a brown substance which is extracted by the naphtha. I then free the residue from the naphtha by evaporation and digest it with methylated spirit … which dissolves out the new colouring matter.*

(Mauve, Simon Garfield, p 6)

**A more modern method for making mauve**

*Caution: Petroleum ether is extremely flammable. All evaporations should be performed under hoods (fume cupboards). Disposal of all chemical wastes should follow the standard procedures.*

*You will need:*
*2.3 ml of water in a 5 ml conical flask, to which add*
*52 µl of aniline*
*60 µl of o-toluidine*
*122 mg of p-toluidine*
*600 µl of 2N sulphuric acid*

*Stir, using a large spin vane, until the reactants have dissolved, heating gently if necessary. After solution, add 30 mg of potassium dichromate in 160 µl of water.*

*Stir for two hours. Very soon after the addition of potassium dichromate the solution will turn a vibrant purple. At the end of the reaction time use a Pasteur filter pipette to draw off the liquid portion, which can be discarded.*

*Transfer the solid to a ceramic filter with a seated filter paper already in place. Using gentle suction filtration, wash the dark solid with distilled water until the washing is clear. Dry the remaining solid in an oven at 110 °C for 30 minutes. Then wash the solid with petroleum ether until the washings are clear. Dry again for 10 minutes at 110 °C.*

*Wash the remaining solid with a 25 percent methanol/water solution until the liquid runs clear, being very careful not to contaminate the product. Evaporate this aqueous/alcoholic solution, transferring to a 5 ml conical flask as soon as the total volume allows. After evaporation is complete, add 300 µl of 100 per cent methanol to the remaining solid, shake to dissolve any soluble materials and use a filter pipette to transfer the liquid to a clean 3 ml flask. Carefully evaporate the liquid in a conical flask until it has a volume of 30 µl or less. As the solution volume gets smaller, the purple colour should grow more intense. This final methanol solution contains the ultimate product – a 2 mg yield of mauve.*

(Mauve, Simon Garfield, p 48 – 9)

# Tasks

## Perkin's patent

1. Make a flow chart showing the steps to make mauve.
2. Underline the chemicals involved in the process.
3. Find out the systematic names, or the names in common use, for the chemicals Perkin used.
4. What is:
    a. the 'black powder' produced in the first stage?
    b. the 'brown substance' produced towards the end?
    c. the reaction producing mauve in the final step involving methylated spirit?
5. If you were to follow Perkin's instructions, what problems would you have to solve?

## The modern process (from about 1970)

1. Make a flow chart showing the steps to make mauve.
2. Underline the chemicals involved in the process.
3. Find out the systematic names or the names in common use for the chemicals used in the process.
4. What is:
    a. meant by '2N' sulphuric acid?
    b. 52 µl of aniline equivalent to in millilitres?
    c. a 'spin vane'?
    d. the 'dark solid'?
    e. happening when the dark solid is washed with petroleum ether?
5. If you carried out this process, what problems would you have to solve?

## Compare the procedures

Use your answers from your work on the two separate processes to answer these questions.

1. What differences do you notice between Perkin's patented process and the modern process?
2. What techniques are used in the modern process that were not available to Perkin?
3. Which process would produce the purer sample of mauve? Explain your answer.
4. How has chemistry changed between the time Perkin patented making mauve and when the modern mauve process was prepared? What is different today?