

FUNDAMENTAL PRINCIPLES OF ORGANIC CHEMISTRY

<https://subarnam.com.np/>

Learning outcomes

By the end of this chapter, Students should be able to:

Detect N, S, and halogens in organic compounds by Lassaigne's test.

13.2 Qualitative analysis of organic compounds (detection of N, S, and halogens by Lassaigne's test)

Detection of foreign elements

As we know, **hydrocarbons and their derivatives** are called **organic compounds**. It means carbon and hydrogen are the essential elements in organic compounds. Many organic compounds include oxygen as well. Besides, a few elements like nitrogen, sulphur, halogens, phosphorus, etc., may be present in organic compounds. These elements are called **foreign elements**.

Generally, foreign elements are detected via the formation of sodium extract, also called Lassaigne's extract. The whole process is called the sodium extract or Lassaigne's extract test. This is done because organic compounds are covalent compounds. Reactions **involving covalent bonds are slow and complex**. It is difficult to test for the presence of foreign elements as such. So, these are first **changed into ionic form by strongly heating them with reactive sodium metal**, whose presence could be easily tested.

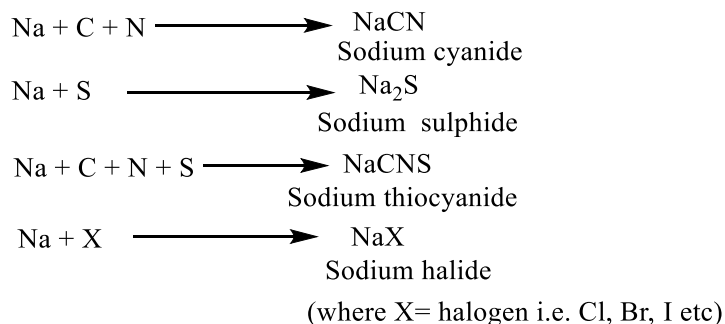
Preparation of Sodium extract or Lassaigne's extract:

Sodium metal is generally stored in kerosene. A small piece of **sodium metal** is taken and dried in the fold of blotting paper. Then it is **kept in a fusion tube** or ignition tube and **heated gently** so that the sodium metal just melts into a shiny globule. Then, after **cooling it slightly**, the **sample of the organic compound**, in which the presence of foreign elements is to be detected, is **added** in an amount nearly equal to the size of sodium. Then it is **heated, first gently, then strongly, until red-hot** and **plunged into a porcelain basin containing water**. The fusion tube and contents are **crushed and warmed, then filtered**. The **filtrate** is called sodium extract or Lassaigne's extract, and it is used to detect foreign elements.

The sodium extract is generally **alkaline** due to the presence of **NaOH** formed by the reaction of water with excess sodium.

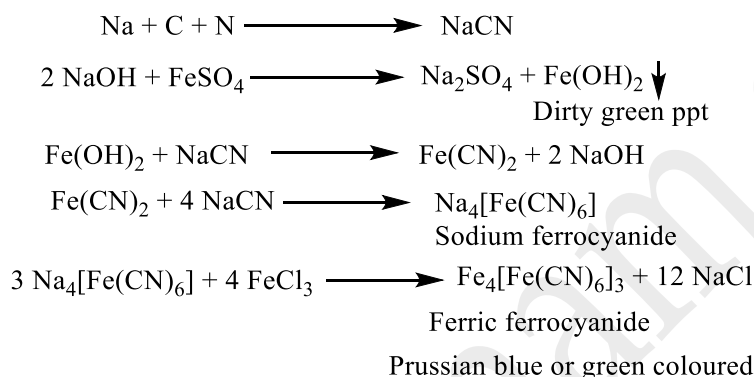


The following reactions occur during the preparation of Sodium extract if N, S, both N and S, or halogens are present in the organic compound, respectively.

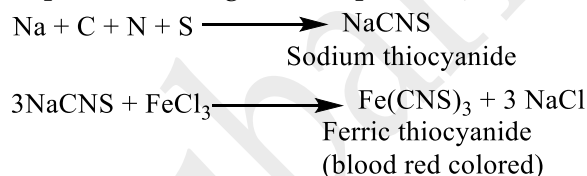


1. Detection of Nitrogen

For the detection of nitrogen, the sodium extract must be alkaline. If it is not, it should be made alkaline by adding a small amount of NaOH solution. About 1 ml of the sodium extract is taken in a test tube, and a few drops of freshly prepared FeSO_4 solution are added. Then it is boiled, where dirty green ppt. is generally formed. After cooling in tap water, a few drops of FeCl_3 are added and acidified with dilute HCl. The formation of Prussian blue or green colouration indicates the presence of nitrogen in the given organic compound. The following reactions are involved.



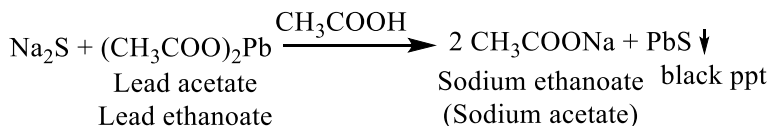
During this test, the formation of blood red colouration indicates the presence of both nitrogen and sulphur in the organic compound. **(Test for both sulphur and nitrogen)**



2. Detection of Sulphur:

The presence of sulphur is detected in two ways.

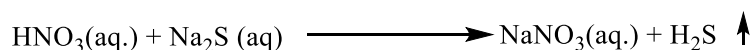
- Lead acetate test: The sodium extract is acidified with acetic acid and then treated with lead acetate. The formation of black ppt. confirms the presence of sulphur.



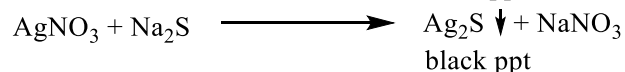
$$\text{Na}_2\text{S} + \text{Na}_2[\text{Fe}(\text{CN})_5\text{NO}] \longrightarrow \text{Na}_4[\text{Fe}(\text{CN})_5\text{NOS}]$$

Sodium nitroprusside Sodium sulphonitroprusside

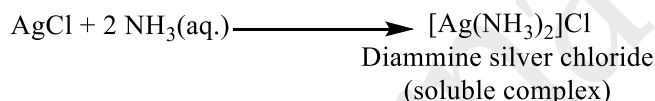
To detect halogens, the first 1 ml of the sodium extract is boiled with dilute nitric acid to remove cyanide or sulphide if present.


$$\text{AgNO}_3 + \text{NaCN} \longrightarrow \text{AgCN} \downarrow + \text{NaNO}_3$$

white ppt


$$\text{AgNO}_3 + \text{NaCl} \longrightarrow \text{AgCl} \downarrow + \text{NaNO}_3$$

white ppt


$$\text{AgNO}_3 + \text{NaBr} \longrightarrow \text{AgBr} \downarrow + \text{NaNO}_3$$

pale yellow ppt


$$\text{AgNO}_3 + \text{NaI} \longrightarrow \text{AgI} \downarrow + \text{NaNO}_3$$

yellow ppt.

<https://subarnam.com.np/>