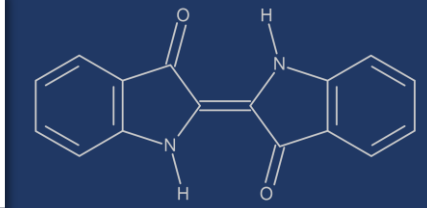
INDIGOTIN

Homi Bhabha Centre for Science Education
HBCSE, TIFR
https://chem.hbcse.tifr.res.in/

Molar Mass : 262.27 g mol^{-1}
Melting point : 390 to 392 °C

Indigofera tinctoria



Indigotin

Indigo dye and Indigotin: Indigotin is the deep blue colored compound present in indigo dye. The dye extracted from natural sources also contain other components along with Indigotin. For more than 4000 years, indigo dye was obtained from *Woad (Isatis tinctoria)* and other plants of Indigofera genus, *Indigofera tinctoria (Indian names- Neel/ Neeli/ Neelum)* being the most common species used.

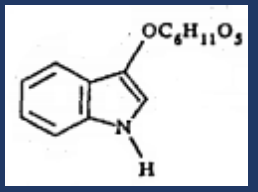
Do you know?

Adolf von Baeyer, the German chemist who pioneered the production of synthetic Indigotin was awarded the Noble Prize in Chemistry in the year 1905.

Production of Indigotin

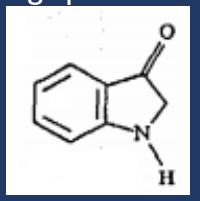
In India, the harvested *Indigofera* leaf bundles are immersed in water tanks and allowed to ferment overnight. During this process, the precursor Indican is converted to Indoxyl by the enzyme indimuslin. For the decomposition of indican, some native groups replace fermentation with an alternate method involving the addition of an acidic decoction of *Eugenia jambolana* bark to the vats.

The extract containing Indoxyl is drained to the next vat and is mechanically agitated to oxidize indoxyl (removal of two hydrogen atoms). A double bond is formed between two of the oxidized indoxyl molecules to produce indigotin. The indigotin formed is insoluble in water and thus, it precipitates. After purification, the product is pressed to form small bars referred to as Indigo cakes. The dye is sold in the market either as Indigo cakes or as Indigo powder.



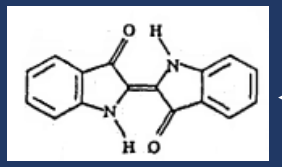
Indican

Enzymatic hydrolysis
- Glucose



Indoxyl

Oxidation
+ Indoxyl



Indigotin

Dyeing with natural Indigo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For dyeing, the insoluble indigo powder needs to be converted to a soluble form, *leucoindigo*, which dissolves in dilute alkaline solution. *Leucoindigo* is produced by adding a reducing agent and a base like sodium hydroxide to a mixture of warm water and Indigo powder. The fabric is dyed in this yellowish-green alkaline liquid.


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On air drying, the yellow Leucoindigo bound to the fabric gets oxidized to blue coloured Indigotin.


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By 1897, BASF, a German chemical company, started mass production of cheaper synthetic Indigo dye with lesser impurities.

Higher demand for Indigo led to newer methods for its synthesis and involved toxic chemicals that harm both human beings and the environment.

Today, more than 40000 tons of Indigo is produced every year and research is being done to develop eco-friendly ways to dye jeans.

The Indigo Revolt

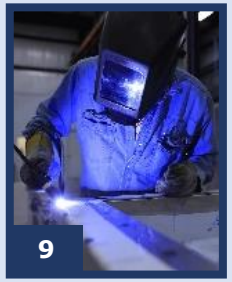
The concept of Indigo plantation was introduced to Indians in 1777 by a Frenchman Louis Bonnard. The dye obtained from the plant was of great commercial value in the European market. Eventually, the Indian farmers were forced by the then East India Company to cultivate more amount of Indigo instead of food crops.

In addition, the farmers were exploited by imposing on them, very high-interest rates for small loan amounts. Under extreme oppression, the farmers started the Indigo revolt *(Neel bidroho)* in the then Bengal, in the year 1859.

The Champaran satyagraha of 1917 led by Mahatma Gandhi, against the European indigo traders and indigo planters, was another significant peasant movement in the history of Indian freedom struggle.

Do you know?

The term "Blue-collar job" used to denote occupations that involve manual or industrial labour, has its origins from the indigo dyed work wears which were used in these jobs to mask dirt & grease.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Applications of Indigo

Indigo is commonly used to dye denim jeans and natural fabrics like wool cotton, silk etc. It is also used for dyeing hair.


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Indigo carmine, a water soluble sodium salt of sulphonic acid derived from Indigotin, is used as a food colourant. It is also used in cosmetics and medicines.

References and Further Reading-

1. Myers, R. L. (2007). *The 100 Most Important Chemical Compounds: A Reference Guide* (1st ed.).
2. Hoover, N. (2019, February 15). How to Dye Natural Fabric With Natural Indigo Powder. Retrieved May 4, 2020, from https://feltmagnet.com/textiles-sewing/How-to-dye-with-natural-indigo (Accessed in April 2020)
3. Pal, S. (2016, October 2). Champaran: Where Mohandas became Mahatma. Retrieved July 26, 2020, from https://www.thebetterindia.com/70247/gandhi-first-satyagraha-champaran/

Image sources

See the supplementary document.

Now, can you find?

Which company was the first to create blue jeans?
Which alkaline substances would have been used in the traditional dyeing process, using Indigo?
How does production of natural Indigo effect the environment and the workers?