

Science of Indigo Dyeing

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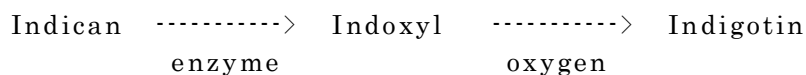
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■ Indigo dyeing

We have two kinds of indigo dyeing. One is an ordinary method by reducing indigotin in the vat. The other is to dip cloth into a juice of fresh leaves of indigo plants. Green leaves of indigo plants contain colorless precursor of indigotin called indican which turns to blue indigotin within the fiber. Indigo dyeing with fresh leaves is an easy method but have a disadvantage that the dyeing can be performed only when and where the fresh leaves can be obtained.

■ Production of indigo

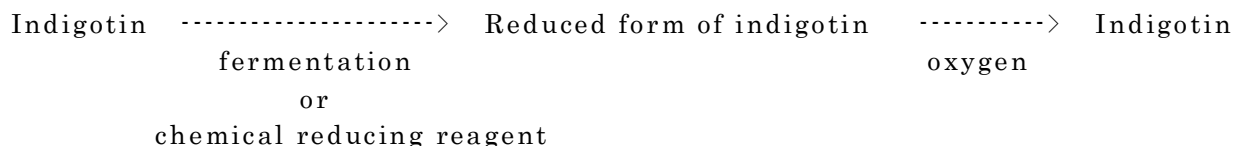
The reason why blue indigotin is produced from green indigo plants is as follows; the precursor of indigotin is a colorless substance called indican which is a glucoside of indoxyl. Indican in fresh green leaves is stable. However, when the leaves are destroyed, indican is hydrolyzed by an enzyme (glucosidase) in the leaves to yield indoxyl which transforms rapidly into indigotin by oxidative dimerization. The reaction scheme is shown below.



When the process occurs within fiber, indigo dyeing is performed and occurs in an extract of indigo plants, indigo paste is obtained.

■ Principle of indigo vat dyeing

Indigotin cannot be used for dyeing directly because it is not soluble to water. Dyeing is quite different from painting. Painting is to attach the pigment to the surface of the cloth. But to dye cloth colorants must penetrate into fiber. Insoluble indigotin cannot penetrate into fiber. However reduced form of indigotin is soluble to an alkaline solution. Modern method for the reduction of indigotin is to use reducing reagents such as sodium hydrosulfite. In ancient time people found to use fermentation for the reduction of indigotin.



■ Application of indigo dyeing with fresh leaves of indigo plant

Purple shade is sometimes obtained in the process of indigo dyeing with fresh leaves of indigo plants. This color is due to the addition of red of indirubin which is an isomer of indigotin. It is known that sometimes small amount of indirubin is formed by the side reaction of indican in the process of producing natural indigo from genus *Indigofera*. If much indirubin is formed in the dyeing with fresh leaves of indigo plants, purple which is rare shade from natural dyes is to be obtained from the easily cultivated plant. The method to get purple will be discussed.