# DYE REMOVAL BY SQUID SHELL POWDER AS ADSORBENT

**N. Saranraj**

*PG Scholar Department of Civil Engineering, Pandian Saraswathi Yadav Engineering College, Sivagangai, India*

***Abstract***

*In our daily life we are facing pollutions like air and water pollution. Water plays the major role in our daily life, but water was more polluted by the waste water (sewage) mixed with fresh water. Water gets polluted mainly by industries like Paper industries, Leather industries and textiles, etc., Textile wastes (DYE) plays an important role in polluting water sources. Dying mills use many kinds of artificial composite dye & discharge large amounts of highly coloured waste water. Different colouring agents like dyes, inorganic pigments, tannins, lighing etc, usually impart colour. Dye wastes are pre-dominant. There are some methods used for the treatment of dye containing waste water, coagulation, rapid sand filter method and oxidation method etc., These methods are not economical. So we choose adsorption method which is economical. The results show higher efficiency of removal was 94% at the pH level 4 under the dosage level 8 mg/l.*

## Introduction

Dyes have long been used in dyeing, paper and pulp, textiles, plastics, leather, cosmetics and food industries. Colour stuff discharged from these industries poses certain hazards and environmental problems. These coloured compounds are not only aesthetically displeasing but also inhibiting sunlight penetration into the stream and affecting aquatic ecosystem. Dyes usually have complex aromatic molecular structures which make them more stable and difficult to biodegrade. Furthermore, many dyes are toxic to some microorganisms and may cause direct destruction or inhibition of their catalytic capabilities. Textile industry use dyes and pigments to colour their product There are more than 100,000 commercially available dyes with over 7x105 tones of dyestuff are produced annually. Many types of dye are used in textile industries such as direct, reactive, acid and basic dyes. Most of these dyes represent acute problems to the ecological system as they considered toxic and have carcinogenic properties. which make the water inhibitory to aquatic life. Due to their chemical structure. dyes possess a high potential to resist fading on exposure to light and water. The main sources of wastewater generated by the textile industry originate from the washing and bleaching of natural fibres and from the dyeing and finishing steps Given the great variety of fibres, dyes and process aids, these processes generate wastewater of great chemical complexity and diversity, which are not adequately treated in conventional wastewater treatment plant. Numerous studies have been conducted to assess the harm impacts of colorants on the ecosystem. It was found that colorants may cause problems in water in several ways:

(i) Dyes can have acute and/or chronic effects on exposed organisms with this depending on the dye concentration and on the exposure may cause abnormal coloration of surface waters which captures the attention of time.

(ii) Dyes are inherently highly visible, minor release of effluent may cause abnormal coloration of surface waters which capture the attention of both the public and the authorities.

(iii) The ability of dyes to undergo absorb/reflect sunlight entering the water this has drastic effects on the growth of bacteria and upset their biological activity.

(iv) Dyes are many different and complicated molecular structures and therefore, are difficult to treat and interfere with municipal waste treatment operations.

(v) (Dyes in wastewater undergo chemical, biological changes, consume dissolved oxygen from the stream and destroy aquatic life. There are various conventional method of removing dyes including coagulation and flocculation, Oxidation or zonation and membrane separation. However, these methods are not widely used due to their high cost and economic disadvantage Chemical and electrochemical oxidations, coagulation are generally not feasible on large scale industries. In contrast, an adsorption technique is by far the most versatile and widely used. The most common adsorbent material is silica, metal hydroxides and activated carbon. As proved by many researchers removal of dyes by adsorption is economically favourable and technically easier. Clay is widely used as an adsorbent due to high adsorption capacity, high surface area, micro porous structure, and high degree of surface respectively.

**Adsorption Principles**

Adsorption is a process that occurs when a gas or liquid solute accumulates on the surface of a solid or a liquid, forming a molecular or atomic film. In other words, adsorption is the adhesion of atoms, ions, bio molecules or molecules of gas, liquid, dissolved solids to a surface and this process creates a film of the adsorbate (the molecules or atoms being accumulated on the surface of the adsorbent. It is a surface phenomenon and a consequence of surface energy. The atoms on the surface of the adsorbent are not wholly wounded by other atoms and thus, can attract adsorbates. The exact nature of bonding depends on the details of the species involved, but the adsorption process is generally classified as follows:

**(i) Physisorption**

It is a type of adsorption in which the adsorbate adheres to the surface through Van der Walls (weak intermolecular interaction)

**(ii) Chemisorptions**

It is a type of adsorption whereby a molecule adheres to a surface through the formation of chemical bond Absorption take place primarily on the walls of the pores or at specific sites inside the particle. As the pores are generally small, the internal surface area is greater the external surface area .Separation occurs because differences in molecular weight, shape or polarity cause some molecules to held strongly enough to allow completely removal of that component from the fluid.

**Removal Methods**

There are various conventional methods of removing dyes including coagulation

**Coagulation**

In water treatment, coagulation is a process that occurs when a coagulant is added to water to "destabilize" colloidal suspensions. Conversely flocculation involves the addition of polymers that

clump the small, destabilized particles Together into larger aggregates so that they can be more easily separated from the water.

**Flocculation**

Flocculation refers to the process by which fine particulates are caused to clump together into a floc. The floc may then float to the top of the liquid (creaming), settle to the bottom of the liquid (sedimentation), or be readily filtered from the liquid.

**Oxidation**

If you are a fan of oxygen-based cleaners or grateful for the sterilizing powers of hydrogen peroxide, then you have oxidation to thank. On the other hand, if you've ever had to deal with a rusty car or toss out browned fruit, then you have oxidation to blame. Oxidation may be a spontaneous process or it may be started artificially. Sometimes it is helpful, and sometimes it is very destructive. At its most basic level, oxidation is the loss of electrons. It happens when an atom or compound loses one or more electrons. Some elements lose electrons more easily than others. These elements are said to be easily oxidized Generally speaking, metals including sodium, magnesium, and iron are easily oxidized.

**Activated carbon**

Activated carbon is the conventional and most studied adsorbent. The ability of charcoal to remove odour and taste was observed centuries ago. According to a Sanskrit manuscript from circa 200BC,"it is good to keep water in copper vessels to expose it in sunlight and to filter it through charcoal," Activated carbon is porous material which is commercially used for the removal of liquid and gases pollution owing to its large surface area.

**DYE**

A dye is a colored substance that has an affinity to the substrate to which it is being applied. The dye is generally applied in an aqueous solution, and may require a mordant to improve the fastness of the dye on the fiber.

**Synthetic Dyes**

Until the latter half of the 19th century people were using natural dyes for colouring of textiles. Different parts of the plant were used to obtain various shades. After invention of synthetic dyes, natural dyes are not used because of the advantage of synthetic dye over natural dye in respect of application, colour range, fastness properties, and availability. But, some synthetic dyes are hazardous, carcinogenic and also release vast amount of pollutant in the environment during their manufacturing. The world is slowly realizing the damaging effects of several chemicals that are synthesized by men in laboratory. Ecology and pollution have therefore become a major concern to all. Green house effect, ozone layer depreciation, water pollution and improper waste disposal have become important issues. So, all developed countries are looking for safe environment. In this

context, the textile industry, which uses hundreds of chemicals in production, from raw material to disposal, is generally regarded among the most polluting industry.

**Natural Dyes**

Natural dyes comprise those colourants (dyes and pigments) that are obtained from animal or vegetable matter without chemical processing. The word 'natural dye covers all the dyes derived from the natural sources like plants, animal and minerals. Natural dyes are mostly non substantive and must be applied on textiles by the help of mordants, usually metallic salt, having an affinity for both the colouring matter and the fibre. Transition metal ions usually have strong coordinating power and/or capable of forming week to medium attraction interaction forces and thus can act as bridging material to create substantivity of natural dyes when a textile material being impregnated with such metallic salt (i.c.mordanted) is subjected to dyeing with different natural dyes, usually having some mordantable groups facilitating fixation of such dye. These metallic mordents after combining with dye in the fibre, forms an insoluble precipitate or lake and thus both the dye and mordant get fixed to become washing fast to a reasonable level.

**Materials and Apparatus Used**

**Material Preparation**

Squid Shells are generally available near all the Seashore areas. They were collected and crushed to the extreme by using the ball mills and sieved to 25μm. These collected samples are then washed with the distilled water for the number of times until the dust particles in the squid shell material is completely removed. The powder is then filtered by using the filter paper. The wetted squid shell materials are dried by oven or by sun dried. These dried samples are used as adsorbent.

**Adsorbate Preparation**

20 gram of dye powder is taken in the beaker along with the wetting oil, then the 20 gram of general salt is added and them mixed with the 20 gram of soda ash and 10 gram of caustic salt . These were mixed at correct proportion to prepare the dye . Later the desired amount of dye powder is mixed with distilled water to prepare the dye solution

20gm of dye + 5ml of wetting oil + 20gm of salt + 20gm of soda ash + 10gm of caustic salt.

**Experimental Setup**

**Procedure**

The dye solution is prepared using 1litre of distilled water mixed with dye concentration of 35 mg at pH of 4. The initial concentration is measured with UV spectrometer by setting the wavelength of 520nm. The dye solution is then separated in conical flasks of about 200 ml and the adsorbent of 2g, 4g, 6g, 8g were added to the various conical flask and kept at shaker at 120rpm for 30 minutes then 20 mL of solution is taken from conical flask without disturbing the actual dye

solution and measured for the first concentration similarly the concentration of solution is measured at the regular interval of 30 mins, 60 mins, 90 mins, 120 mins

**Varying Dye Concentration**

The dye solution is prepared for the various concentrations of 25mg/l, 50mg, 75 mg, 100 mg which were mixed per litre and above experiments were carried out.

**Varying Adsorbent**

The dye solution is prepared for concentration of 25 mg/l at pH of 4 and the adsorbent of 2g, 4g, 6g, 8g were added to the various conical flask and above experiments were carried out . Similarly the adsorbent dosage were varied for the concentration of 50 mg, 75 mg , 100 mg for the different pH of 4, 7, 10

**Varying reaction time**

The dye solution is prepared for dye concentration of 25 mg/l at pH of 4 and the adsorbent dosages were added. The concentration of dye solution is measured periodically for every 30 minutes by using the UV spectrometer. Similarly the reaction time is varied for the concentration of 25mg/l, 50 mg/l, 75 mg/l , 100 mg/l for the different pH of 4 , 7 , 9 and for the adsorbent dosage of 2g, 4g, 6g and 8g.

**Graph**

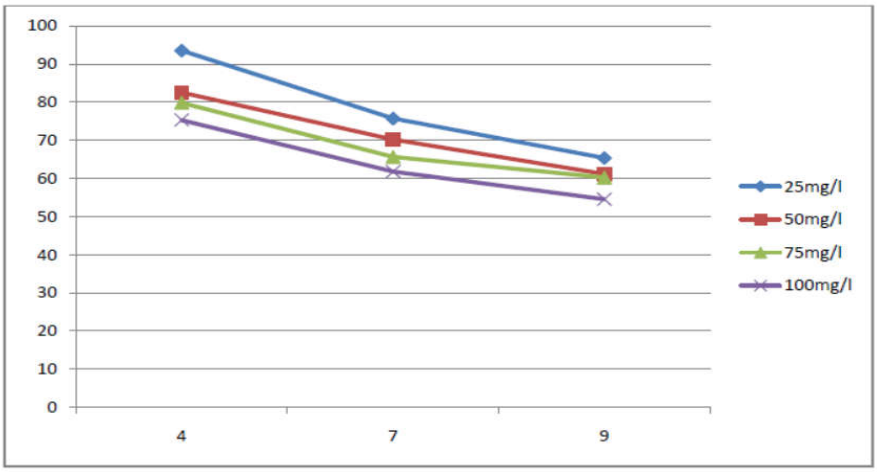


**Figure 1 Ph Vs % of Adsorption**

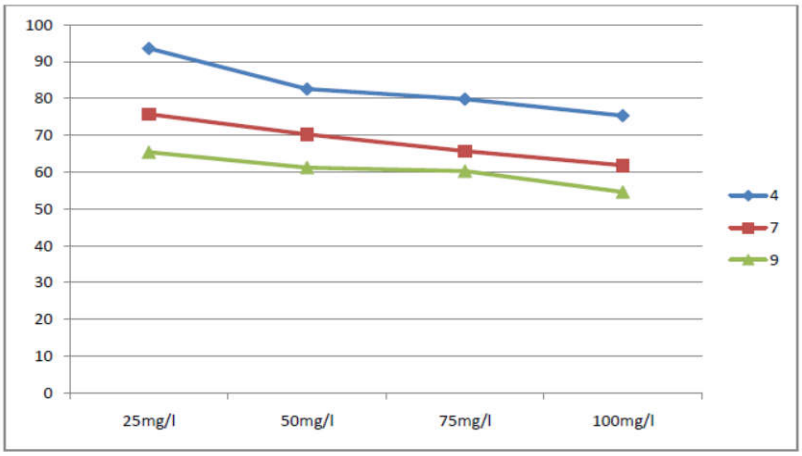


**Figure 2 Initial Concentration Vs. % of Adsorption**

From the above graph it is clearly mentioned that by decreasing the pH the percentage of removal is maximum, by changing the contact time that there is no such difference after the 30 minutes, by increasing the initial concentration the percentage of removal falls.

## Conclusion

Adsorption is the easiest and economical method for the removal of dye in textile waste water. In this project, natural adsorbent is used which is the powder obtained from the Squid shells. Squid shells are easily available and it is low cost adsorbent. Navy blue is one of the mostly used colours in all kinds of dyeing industries. There are about 55-75% of Navy blue dye is present in each materials coming out from the dyeing industries. They are by varying the dye concentration, varying the adsorbent quantity, varying the reaction time. All the observations are noted and plotted as individual graphs. Among the three results and graphs, varying the reaction time gives high efficiency Hence we conclude that varying the reaction time is the best method for the adsorption procedure. By decreasing the pH the percentage of removal is maximum, by changing the contact time that there is no such difference after the 30 minutes, by increasing the initial concentration the percentage of removal falls. The results show higher efficiency of removal was 94% at the pH level 4 under the dosage level 8 mg/l.

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