

HAZARDS ASSOCIATED WITH DYING IN FINISHING PROCESS OF A TEXTILE INDUSTRY

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Abstract -Textile industries in order to give finished cottons it undergoes several process one among them is dyeing process. The dyeing process is the most hazards process among all the textile industry processes. The hazards are caused due to the chemicals used in the dyeing. The chemicals as a common have some hazards which will lead to severe affects when its exposed continuously as well as it leads to fire when not stored properly. The improper treatment of water leads to the affect of water streams thus affecting both aquatic and terrestrial life. Dyes are further classified in to several other classes of dyes each dye have its own hazards based on the different chemicals used in the particular class of dye. Some of these very hazards chemicals include benzedine, hydros, potassium dichromate,alkyl amine,etc.,Thus its very important to known about the various hazards that we are exposed to due to dyeing process as well hazards that is caused due to usage of substrate that are dyed using highly toxic materials.

Key Words: Dyeing process, Textile industry, Azo dyes, Hazards, Natural dyes

1. INTRODUCTION

Textile finishing which deals with providing of better fibers for usage includes three processes they are preparation; dyeing and after finishing. Among these processes in this paper we will deal with hazards associated with dyeing process. Dyeing is the homogeneous colouration of textile substrates using dyes in order to improve the substantivity of the fibers and improve wetting, dispersion, leveling and other properties of dyes by adding surfactants [1].In simple words dyeing is the process of adding colour to the cellulosic materials in order to improve the abrasion resistance, resistance to insects, shrink proofing, to develop wrinkle resistance, etc., [2, 3].Dyes are further classified as natural dyes and synthetic dyes. The dyes that are obtained from the natural sources are termed as natural dyes. During ancient period the colouring pigments where obtained from natural resources like coloured rock, minerals and dyes from animals and plants. Historic records shows that from 3500BC itself the colour dyes extracted from fruits, flowers, insects and fish where in use. [4, 5].Natural dyes production requires a vast area of land and its expensive, the affinity toward the fibers was very poor and its

adherence of colour was very poor over the fabrics. But the natural dyes also have its own hazards, such as they have to use mordants in order to create a bite of colour over the fabrics. The mordants commonly used are metals like sulphates, chlorides ,etc., These metals when in soluble form reacts with the microorganisms thus leading to change of activities of enzymes like filling of bones with lead instead of calcium and further leading to mutagenic breakdown process.[6,7,8].This lead the way to the synthetic dyes. The synthetic dyes are generally prepared from petroleum byproducts and earth mineral types of synthesis resources. William Henry Perk in 1856 tried to synthesise quinine but it was a failure, it coincidentally led to the discovery of "Mauvenine" the first man made organic aniline die[2]. The synthetic fibers let to the improvement of dyeing process in textile industries. But due to use of synthetic dyes the textile industries became the NO.1 polluters of clean water. Nearly 1.6 million liters of water is being in a medium sized textile mill which have a production of about 8000kg fabric per day.15% of water is spend in dyeing process. So on an average 15% - 20% of clean water is being polluted when a yarn of 1kg requires 60 liters of water for dyeing. Thus when 80% of dyestuff stays on a fabric remaining gets drain in fresh water. [5]. This thus creating a huge impact on environment as well as the human beings.

2. COMMON HAZARDS DUE TO DYEING PROCESS:

2.1. FIRE HAZARD:

Fire hazard is one of the common hazards that prevails in the dyeing industries. The use of flammable liquids without any prior precautions such as improper storage facilities; not properly designed storerooms, not constructed of fire resistance materials with a raised and ramped sill in the doorway thus letting all the liquid to flow to the ignition region and causing a massive fire. The presence of oxidizing agents such as hydrogen peroxide may lead to increase the intensity of the fire by fuelling with oxygen. The presence of large quantities of dry fabrics and paper may also lead to huge fires. Insulation damages in electrical wiring may also cause fire.[9].

2.2. ACCIDENTS

When a hot liquor is admitted in to the kier where the worker has been arranging the clothes that are to treated may be affected by serious burn injuries(scalding).This mostly occurs when the valves are accidentally opened or when the hot liquor is discharged through the common duct.[10]

2.3. CHEMICAL HAZARDS:

The use of chemicals such as hypochlorite used as bleaching solution possess gaseous substance chlorine. When the workers come in contact with dangerous level of chlorine they develop skin irritation, mucous membrane gets affected and thus leading to pulmonary tissue damage thus causing lung edema. The acid and alkalis used in dying process for treatment of cloth with boiling liquor expose the workers are risk to the burns and scalds. The chips flying from metals like chromium becomes hazardous when it strikes the person. Aromatic amines used in dying industries has the capability of DNA mutation. Most of the dye stuff used in the industries are skin irritants. [10]

2.4. HAZARDS IN WATER STREAM:

Improper effluent treatment in the textile industries is a major reason for water pollution. The sludges that are formed are not treated properly and let in to the water stream thus not letting sunlight to pass through the surface of the water body thus providing required oxygen level to the aquatic creatures. Azo dyes if they are not properly treated the may be carcinogenic or mutagenic thus endangering the human health.[5].

3. HAZARDS BASED ON CLASSES OF DYES

Acid or base dyes used for wool, silk or cotton. Direct dyes are very fast and used in wool and rayon. The sulphur dyes are used on cellulosic materials. Next is azo type dye this is created by dissolving naphthol in aqueous caustic soda. The Vat dyes are made into leuco compounds with sodium hydroxide and sodium hydrosulphite. Disperse dye is used for all synthetic fibers. While the mineral dyes are inorganic pigments which are salts of iron and chromium. Reactive dyes are used in hot or cold bath of soda ash and common salt for cotton. Each classes of of dyes has its own hazards associated with them based on the chemicals used.[10]

3.1 SULFUR DYE:

Sulfur dyes (fig.1) are synthetic organic substantive materials dyes for cellulosic.

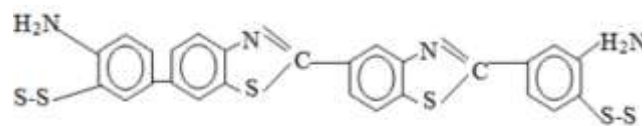


Fig 1- Chemical Structure of sulphur dyes

Sulphur dyes are water insoluble dyes hence it's made soluble by addition of alkaline compounds such as sodium sulphide or sodium hydrosulphide which acts as a reducing agent. It also use oxidizing agents such as sodium dichromate and hydrogen peroxide.[11,12].The oxidizing agents used are mostly bleaching agents, the chemical reaction of peroxide bleaching must be controlled by adding the agents constantly rather at a single flow which may lead to oxygen evolution due to decomposition of hydrogen peroxide. When the oxygen level increases than that of the relief device can withstand it leads to severe vessel failure. Thus the reducing agents generate more heat leading to explosion. Formaldehyde is also one of the reducing agents, the exposure of formaldehyde will lead to cancer on nose, lung and brain. It also causes respiratory difficulties and eczema(patches on skin with bleeding). [1,13].

3.2 AZO DYES:

These dyes are the most commonly used colourants in the textile industries. The main constitute of azo dyes are aromatic amines. The azo dyes are formed by diazotization in which the aromatic amines are converted to diazonium salts further which undergoes a coupling reaction .The azo dyes contain $-N=N-$.These $-N=N-$ undergoes the bond breakage in order to form $-NH_2$ which is called as amine(fig.2).[14].

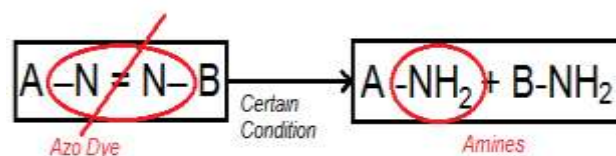


Fig.2- Azo to amine conversion

Amines are carcinogenic in nature thus causing cancer. There are 24 banned amines which is considered as very hazardous when a person comes in contact with these kind of amines(table.1). Human get exposed to banned amines either by direct or exposure of skin to these garments. Ingestion occurs due to sweating which leads the amines to migrate in the body. These thus causes mutagenic changes in the human body[15].

Table 1: Banned Amines

Banned Amines		
S. No.	Substance	CAS No.
1.	4-aminodiphenyl	92-67-1
2.	Benzidine	92-87-5
3.	4-chloro-o-toluidine	95-69-2
4.	2-naphthylamine	91-59-8
5.	o-Aminoazotoluene	97-56-3
6.	2-amino-4-nitrotoluene	99-55-8
7.	4-chloroaniline	106-47-8
8.	2,4-diaminoanisole	615-05-4
9.	4,4'-diaminodiphenylmethane	101-77-9
10.	3,3'-dichlorobenzidine	91-94-1
11.	3,3'-dimethoxybenzidine	119-90-4
12.	3,3'-dimethylbenzidine	119-93-7
13.	3,3'-dimethyl-4,4'-diaminodiphenylmethane	838-88-0
14.	4-cresidine	120-71-8
15.	4,4'-methylene-bis-(2-chloroaniline)	101-14-4
16.	4,4'-oxydianiline	101-80-4
17.	4,4'-thiodianiline	139-65-1
18.	2-aminotoluene	95-53-4
19.	2,4-diaminotoluene	95-80-7
20.	2,4,5-trimethylaniline	137-17-7
21.	2-methoxyaniline	90-04-0
22.	4-aminoazobenzene	60-09-3
23.	2,4-Xylidine	60-09-3
24.	2,6-Xylidine	87-62-7

3.3 REACTIVE DYES

Reactive dyes are used for cotton. They possess a high degree of wetness. Due to this property this acts the similar way as on fibers when ingested in to the body. Two common hazards caused due to reactive dyes are respiratory sensitization and skin sensitization. Symptoms of respiratory sensitization are watering eyes, running nose and blocked airway and it causes symptoms of asthma like unusual breathlessness. When the exposure level of reactive dyes continues even after unusual breathlessness problems it may cause occupational asthma which may lead to death. [16].

3.4 MINERAL DYES

Natural dyes obtained from any minerals like red rock are known as mineral dyes. These mineral dyes does not have the property of mordant towards the fabrics hence they use metals like chromium and inorganic pigments of salt iron. Mostly the metals are micronutrients , but in soluble form they become poisonous on organisms. Thus depending on the dosage level the metal deposits on bones or tissues and block the activity of enzymes further replacing elements like calcium by lead. This also causes damage to the DNA protein. [5]. Chromium used in textile industry becomes very hazards when people come in contact with the continuous exposure. The might lead to

skin rashes, respiratory problem, kidney and liver damage and on a continuous exposure it may lead to lung cancer also. [17].

3.5 DISPERSE DYE:

Disperse dyes are only insoluble dyes they are used in polyester. It's basically based on azobenzene. These dyes are possible to create some reactions when it comes in contact with human bodies. This allergic towards disperse dyes was noticed in 1868. In 1940 nylon stockings were introduced in America which on continuous survey lead to many allergic contact dermatitis problem due to use of disperse dyes like disperse blue 124. Due to improper effluent treatment this lead to many aquatic problem by increasing the toxic levels of water stream making aquatic life a pathetic situation. [18]

3.6 VAT DYES

Dyes like indigo are applied after alkaline reduction which are classified as vat dyes. The effluent from this process contains residuals like dyestuff, reducing agents and oxidizing agents. These dyestuff creates skin irritation. The reducing agent like sodium hydrosulphite used when contaminated with water generates heat and which might lead to ignition. Among all the classes of dyes vat dyes are less toxic to the environment. [1, 19].

3.7 DIRECT DYES

As the name suggest the dye is directly applied to the cellulosic material without any use of mordants. Dyeing with direct dyes requires salt thus the waste water obtained from this process contain a dyestuff of 5% to 20% thus affecting the water streams. Some direct dyes are made of nitrogen compounds which are considered to possess carcinogenic agents in them thus leading to cause cancer on continuous exposure. [19]

4. RESULTS AND DISCUSSION

The textile industry is thus considered to be the more hazardous industries of all the other industries. Though Textile industries, possess other hazards life flying of short fibers in the industries leading to lung diseases; the main hazard is due to the dyeing process. The dyeing process causes both the aquatic life and terrestrial life difficult for survival. There are several common hazards that's been identified due to the use of various chemicals used in dyeing process, which might even lead to explosion when there is no proper decomposition of these chemicals. Further its known that the dyes are classified in different classes of dyes based on its usage on different fabrics and the chemicals used in their process. Each class of dye is hazards in one way or the other. Among all the classes the most hazardous class of dye is azo dye as aromatic amines caused in azo dyes leads to severe DNA changes and it causes blood cancer (leukemia) and it was

also studied that vat dyes are less toxic to environment when compared to other classes of dyes. On the whole the dyeing process not only causes affects to people who are working in the textile industry but even to people who are utilizing dye coated fabrics.

5. CONCLUSION

The use of synthetic dyes in place of natural dyes due to its cost effectiveness, substantivity on fabrics, easy dispersion of dyes, etc., lead to the depletion of natural dyes. Though the synthetic dyes possess the most advantages than the natural dye it with holds the severe disadvantage that's the hazardous nature of it, towards the environment. Their are several chemicals used in each classes of dyes and no chemical is proven eco-friendly. Though the natural dyes are evolving now a days they don't have important property of mordant on fibers. Thus this leads to use of mineral dyes and making natural dyes also hazardous. Thus in no way dyeing process can be considered as a eco friendly process.

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