EVALUATION OF KNOWLEDGE OF EFFLUENT TREATMENT TECHNIQUES AMONG TEXTILE DYES (LOCAL INDUSTRY) IN ITOKU, ABEOKUTA SOUTH LOCAL GOVERNMENT IN OGUN STATE

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Abstract

The textile industry positively affects economic development worldwide. China is the largest exporter of all types of textiles, followed by the European Union, India, and the USA (Ghaly et al., 2014). However, one of the problems associated with Textile factories is the unacceptable Effluents, especially dyes, which are difficult to degrade. In this study, a local industry will be considered: Itoku in Abeokuta South Local Government, Ogun State. The simple size is the total number of registered dyers in Itoku: 150 members. A standard questionnaire was used to obtain data from respondents. Moreover, analysed using mean, frequency, percentage, standard deviation.55.5 percent male filled the questionnaire, 63.6% are single, 50.1% are Islam, 67.3% have secondary school certificate,97% are into full time, 80%own a production site, 100% are aware of the danger caused by Textile Effluent,78% are aware of the health problems associated with effluent, 90% are aware of serious damage to floral (plant),86.4% agree that gloves does not play the role of poisonous prevention for my skin, 17.3% agree that effluent cause premature deliverii, 26.4% agree that effluent cause feeling of suffocation, 30.0% agree that effluent cause serious sneezing. The main objective of the study is to evaluate treatment techniques for textile dyes in Itoku, Abeokuta South.

Introduction

In Nigeria, industrial effluents are among the sources of heavy metals in the environment. Textile industries produce large amounts of polluted effluent, which contains chromium, cadmium, Manganese, copper, and lead (Poornima et al. Al 2011). The effluent (both treated and untreated) is discharged into nearby land and water, and the heavy metals enter the human body through fish, milk, and meat of animals fed on plants.

Zn, Pd, cr and Cd cause human disorders, for instance, lung cancer, chest pain, cough, vomiting, nausea, diarrhea, dry throat, and headache (Deepali & Gangwar, 2009)

The textile Industry is primarily concerned with the design, production and distribution of yarn, cloth and clothing. The raw material may be natural or synthetic, using products of the chemical Industry.

The textile industry takes the largest share due to its ability to create a variety of job

opportunities and its integration with different economic sectors, both globally and locally. It is the most expanding and emerging sector. Amare, Esayas and Teshale (2021). The textile industry is one of the largest and most complex industrial chains in manufacturing. The production of textiles requires several stages of mechanical processing, such as spinning, knitting, weaving, and garment production, which seem to be insulated from wet treatment processes, such as sizing, desizing, scouring, bleaching, mercerising, dyeing, printing, and finishing (Risteski, Saska & Zhezhova, 2014). Industries positively affect economic development worldwide. China is the most important exporter of all types of textiles, followed by the European Union, India and then the USA (Ghaly *et al.*, 2014)

The dyeing process is an important step in Textile manufacturing. During this stage, the colour is added to the fibres, and various chemicals may be used to enhance their adsorption. When the final product is ready after the finishing process, some of these dyes and chemicals become part of the textile industry Effluent (Carmen and Daniela 2012). These dyes and chemicals, in addition to their unacceptable appearance and toxic effects upon breakdown, may contaminate nearby soil, sediment, and surface water, posing a major global environmental pollution challenge.

Plate1. A dyer with different bowls of dye solution source: Labode 2023

Effluent can be defined as liquid waste discharged into a river or the sea according to the Longman dictionary. Also, the United States Environmental Protection Agency has described effluent as "wastewater - treated or untreated - that flows out of a treatment plant, sewer, or industrial outfall. Generally, refers to wastes discharged into surface waters". The Compact Oxford English Dictionary defines effluent as "liquid waste or sewage discharged into a river or the sea".

Effluent in the artificial sense is, in general, considered to be water pollution, such as the outflow from a sewage treatment facility or the industrial wastewater discharge from industrial facilities.

The effluent discharged from textile factories is a mixture of dyes, metals and other pollutants. The colourants can be

divided into natural and synthetic dyes. Synthetic dyes are easily produced in different colours and are characterised by their fastness, which makes them more widely used than natural dyes (Khehra *et al.* 2006). Synthetic dyes are classified based on their chemical structure (e.g., azo, sulphur) and mode of application (e.g., reactive, direct, disperse, basic, and vat dying) (Popli and Patel, 2015).

The dye effluent is high in colour, pH, suspended solids (SS), chemical oxygen demand(COD), biochemical oxygen demand (BOD) (Yaseen and Scholz 2016), metals (Sharma et al. 2007; Sekomo et al.2012), temperature (Dos Santos et al.2007; Shah et al. 2013) and salts.

The treatment of textile effluents is necessary to protect the ecosystem and enable the subsequent recycling of treated effluent for irrigation or reuse within textile factory processes. (Scholz [1] [2] [3] and Yasser 2018)

There are two possible locations for treating the effluent: the textile factory or the sewage works. The advantage of treating wastewater in the Textile factory is that it provides partial or full reuse of water. Produced wastewater has to be cleaned of fats, oils, and other chemicals used during several production steps.

The treatment Processes may be categorised into primary, secondary and Tertiary treatment processes. The main purpose of secondary treatment is to provide biochemical oxygen demand (BOD) removal beyond what is achievable by simple sedimentation. It also removes an appreciable amount of oil and phenol. The Textile waste also contains significant quantities of non-biodegradable chemical polymers. Since the conventional Treatment methods are inadequate, there is a need for efficient tertiary treatment.

Textiles are considered the most polluting element in the textile industry. It affects the environment. Wastewater becomes the main source of environmental pollution. It polluted the surface and subsurface water, soil and air. Today, proper management and remedial measures, such as disposal systems, are the most serious challenges worldwide, including Abeokuta in Ogun State.

The textile industry generates large amounts of wastewater containing toxic and hazardous pollutants that severely degrade the environment. Textile industry wastewater is toxic to aquatic macrophytes and algae, as macrophytes can survive for only 2 days in textile effluent.

The textile effluent pollutes the soil. The soil is the most important medium for growing plants, bushes, crops, etc. The

quality of crops depends upon the quality of the soil. So, when soil quality decreases due to polluted industrial wastewater, the amount and quality of crops also decline. It is also observed that the lower lands become more polluted than the higher lands, as the effluent ultimately deposits there.

Wastewater is considered the most polluting element in the Textile Industry because it affects the environment, It is the main source of pollution to the environment hence it requires the input of a wide range of chemicals and dye stuffs which are organic compounds of complex structure, There should be a proper knowledge and awareness on effluent in General Most of the researcher do not look into local industry, how they dispose their waste, the health implications of effluent on the dyers and the problem the face with water scarity

OBJECTIVE OF THE STUDY

The objective of the study is to evaluate the effluent treatment techniques for textile dyes in Itoku, Abeokuta South Local Government, Ogun State.

The Specific objective of the study is to;

1. Describe the socio-economic characteristics of the respondents,
2. determine the awareness of textile waste treatment by the respondents,
3. assess the knowledge of the respondents in textile waste treatment,
4. examine health-related issues associated with textile effluent treatment techniques,
5. Assess the perception of respondents about textile Effluent

SIGNIFICANCE OF STUDY

There is no significant relationship between respondents' knowledge and their perception of textile effluent in the environment. The findings of this study help local Dyers (in Itoku) understand the implementation of effluent in their environment (soil, water, and Air pollution) and its impact on their health. This revealed that there is no significant relationship between the socio-economic characteristics of the respondents and the perception of textile effluent in the environment. It also helps them get the necessary information. Concerning effluent in the textile industry.

SCOPE OF STUDY

The study will cover all registered Textile Dyers in Itoku, examining how effluent is treated, how they dispose of their waste, the chemical composition of the effluent, its environmental impacts, and the health implications for the dyers.

DEFINITION OF TERMS

1. KNOWLEDGE: can be defined as awareness of facts or as practical skills, and may also refer to familiarity with objects or situations.
2. EFFLUENT: Effluent is defined by the United States Environmental Protection Agency as "wastewater - treated or untreated - that flows out of a treatment plant, sewer, or industrial outfall. Generally refers to wastes discharged into surface waters. The Compact Oxford English Dictionary defines effluent as "liquid waste or sewage discharged into a river or the sea".
3. EFFLUENT TREATMENT: the removal of impurities from wastewater, or sewage, before it reaches aquifers or natural bodies of water such as rivers, lakes, estuaries, and oceans. Since pure water is not found in nature
4. TECHNIQUES: The basic method for making or doing something, such as an artistic work or scientific procedure. Alternatively, a method of achieving something or carrying something out, especially one requiring some skill or knowledge.
5. **TEXTILE:** A textile is a flexible material made by creating an interlocking bundle of yarns or threads, which are produced by spinning raw fibers (from either natural or synthetic sources) into long and twisted lengths. Textiles are then formed by weaving, knitting, crocheting, knotting, tatting, felting, bonding, or braiding these yarns together.
6. **DYER:** someone whose job is dyeing cloth or other material (changing its colour using a special liquid)
7. **ITOKU** is a region in Nigeria, and it is part of the Abeokuta South Local Government Area, Ogun State

Plate2: Different bowls of dye solution and fabrics. Source: Labode 2023

Effluent

The textile industry is one of the largest sources of liquid effluent pollutants, due to

the high volumes of water used in dyeing processes. The chemical composition includes a wide range of pollutants, including inorganic compounds, polymers, and organic products. Treatment of textile dye effluent is difficult and ineffective with conventional processes because many synthetic dyes are highly stable in light and at high temperatures, and they are also non-biodegradable. (Alejandra, Moisés, Rosa María and Ivonne2018)

The implication is the pollution of surface water, with consequent effects on human health. Effluents from industries have been known to contaminate water, soil, and air, resulting in a heavy disease burden and a shorter life expectancy in developing countries. The presence of poisonous chemicals in industrial effluent may pose a health threat to both humans and animals, as well as contamination of water quality (AWOMESO, TAIWO, GBADEBO and ADENOWO, 2010)

The effluent discharged from textile factories is a mixture of dyes, metals and other pollutants. The colourant can be divided into natural and synthetic dyes. Synthetic dyes are easily produced in different colours and are characterised by their fastness, which makes them more widely used than natural dyes (Khehra et al., 2006). Synthetic dyes are classified by chemical structure (e.g., azo, sulphur) and mode of application (e.g., reactive, direct, disperse, basic, and vat dying) (Popli and Patel 2015).

The dye effluent is high in colour, pH, suspended solids (SS), chemical oxygen demand(COD), biochemical oxygen demand (BOD) (Yaseen and Scholz 2016), metals (Sharma et al. 2007; Sekomo et al.2012), temperature (Dos Santos et al.2007; Shah et al. 2013) and salts. Some heavy metals contained in effluent (either in free form in the effluent or adsorbed in the suspended solids) from the industries be carcinogenic (Tamburlini et al, 2002) while other chemicals equally present are poisonous depending on the dose and exposure duration (Kupchella and Hyland, 1989) these chemicals are not only poisonous to human but also toxic to aquatic life (WHO, 2002) and may result in food.

Real Textile Effluent

Typical Characteristics of Textile Effluents

The effluents discharged from textile factories are a mixture of dyes, metals and other pollutants. The colourants can be divided into natural and synthetic dyes. Synthetic dyes are easily produced in different colours and are characterised by their fastness, which makes them more widely used than natural dyes (Khehra et al. 2006). Synthetic dyes are classified into different groups according to their

chemical structure (e.g. azo, anthraquinone, sulphur, phthalocyanine and triarylmethane) and according to their mode of application (e.g. reactive, direct, disperse, basic and vat dying) (Popli and Patel 2015). The dye effluents are high in colour, pH, suspended solids (SS), chemical oxygen demand (COD), biochemical oxygen demand (BOD) (Yaseen and Scholz 2016), metals (Sharma et al. 2007; Sekomo et al. 2012), temperature (Dos Santos et al. 2007; Shah et al. 2013) and salts. Therefore, during treatment processes, it is important to monitor and compare these parameters with the standard concentrations before discharging the effluent into the receiving water body. The presence of poisonous chemicals in industrial effluent may pose a health threat to both humans and animals, as well as contamination of water quality (AWOMESO, TAIWO, GBADEBO and ADENOWO, 2010)

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WET OPERATION PROCESS

Sizing and De-sizing Operation Process

In wet processes, during fabric sizing, several chemicals are used, including starch, enzymes, waxes, and ammonia. The presence of starch hinders the dye molecule's diffusion into the fabric, so the starch must be removed before dyeing. The effluent from de-sizing and sizing unit processes has highly dominant biological oxygen demand (BOD) in the range of

300-450ppm and a solution of pH of 4-5. These have a limited acceptable growth temperature of at least 12c (54 F), an optimum of 25-30c (77-86 F), and a maximum of 33-35c (92-95 F) at an optimum pH of 6 to 8, which kills aquatic plants or animals.

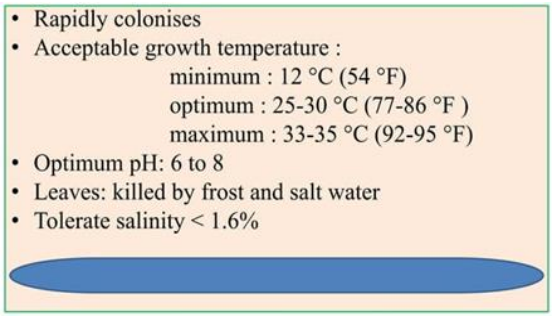

Fig. 1 source: Labode 2024

Mercerisation and dyeing operation process

In the Mercerization process, caustic soda treatment is applied to cotton fibers to improve fiber properties, such as strength and luster, and to permanently impart a greater affinity for dyes and other finish chemicals. Dyeing is a process in the textile industry that involves a combination of chemical or physical (printing) affinity between a fabric and a dye solution to impart colour to the fiber.

STUDY AREA

The Adire market is the biggest in Africa. It is located in Abeokuta, Ogun State. It is known as the Kampala market, while the locals call it the Itoku market. It is the hub of Adire fabric in Nigeria. Adire Mall is an ultra-modern market. Art and culture have been passed from generation to generation. However, the Missionaries introduced the people to cotton in the 1850's, cotton weaving, pottery, and Adire are all crafts of the Abeokuta people. (https://www.travelwaka.com/Adiremarket/#:~:text=Adire%20mall%20is%20an%20ultra,biggest%20Adire%20market%20in%20Africa.)

Adire was first produced in Chief Mrs Miniya Jojola Soetan's compound in Kemta, Abeokuta, by Chief Mrs Miniya Jojola Soetan, the second Iyalode (head of women) of Egbaland.

The first Adire material was made with Teru (local white attire) and Elu (local dye) made from Elu leaf, which is planted in the Saki area of Oyo State.

In the 1930s, men were allowed to partake in Adire making, which was primarily a female craft. In the 1960s, the growing availability of chemical dyes from Europe caused a revolution in the colour and techniques.

Findings of preferences of the respondents on the itemised statements presented to them. The following are the results of the analyses.

Table 1: Awareness of the textile effluent waste treatment of the environment

Awareness of textile effluent waste treatment	**Yes (%)**	**No (%)**
Are you aware of the pre-fabric treatment method	13 (11.8)	97 (88.2)
Are you aware of the danger caused by textile effluent	110 (100.0)	
Are you aware of the health problems associated with the effluent waste to humans	78 (70.9)	32 (29.1)
Are you aware of serious damage to the flora and fauna diversity	109 (99.1)	1 (0.9)
Do you know it causes skin and respiratory diseases	51(46.4)	59 (53.6)
Are you aware of the destruction of the soil pH value due to the effluent of textile treatment	71 (64.5)	39 (35.5)
Are you aware of the pollution caused by the textile effluent	72 (65.5)	38 (34.5)

Knowledge of textile effluent waste treatment for the environment

The results in Table 1 reveal that the majority (90.0%) of the respondents agreed that mixing hydrogen sulphite and caustic soda causes some poisonous gas to be released into the environment. In comparison, the majority (89.1%) agreed that the current process of mixing hydrogen sulphide and caustic soda is safe for workers, and the majority (88.2%) agreed that the poisonous elements in synthetic dyes and chemicals are causing the gas H_2S in the study area. Furthermore, the majority (86.4%) of respondents agreed that wearing gloves does not serve as a protective measure for their skin. In comparison, the majority (68.2%) of the respondents agreed that wearing face masks, nose covers, gloves, and clothing can prevent exposure to chemical gases, and 67.3% agreed that wearing face masks or clothing is enough at work during textile production in the study area. Th. This result is in line with other literature on KAP regarding organic solvents among printing workers in Hong Kong (Hathaway, Proctor and Hughes, 2006), which reported that the workers in the printing industry in which many chemicals are used had a good knowledge about the harmful effects of the chemicals in printing which was excellent and knew that chemicals used in the industry have harmful effects to their health.

Table 2: Knowledge of textile effluent waste treatment of the environment

Knowledge of textile effluent waste treatment for the environment	Yes (%)	No (%)
Mixing of hydrogen sulfide and caustic soda causes the formation of some poisonous gases	99 (90.0)	11 (10.0)
The current process of mixing hydrogen sulfide and caustic soda is safe for workers	98 (89.1)	12 (10.9)
The poisonous element of synthetic dyes and chemicals is causing the gas H_2S	97 (88.2)	13 (11.8)
The gas from dye and chemical mixing is only poisonous to the respiratory organs	22 (20.0)	88 (80.0)
The gas from dye and chemical mixing is not poisonous to the skin	50(45.5)	60 (54.5)
Wearing gloves does not play the role of a protective measure for my skin	95 (86.4)	15 (13.6)
Wearing face masks or clothing is enough at work during textile production	74 (67.3)	36 (32.7)
I need to wear a face mask and a nose cover to avoid the effects of dyes and chemicals on the respiratory system	58 (52.7)	52 (47.3)
Wearing face masks, nose covers, gloves and clothing can prevent the gas from the chemicals	75 (68.2)	35 (31.8)
Wearing only clothing can prevent the effects of hydrogen sulphide and caustic soda on the skin.	61 (55.5)	49 (44.5)

Health-related issues associated with textile effluent waste treatment in the environment

The results in the Table reveal the health-related issues associated with textile effluent waste treatment in the study area. Findings show that 30.0% of the respondents agreed they experienced serious sneezing as a health-related issue associated with textile effluent waste treatment in the environment. In comparison, 26.4% of the respondents agreed that they experience feelings of suffocation, and 20.0% of them experienced vomiting as a health-related issue associated with textile effluent waste treatment in the environment in the study area. The majority of respondents sampled for this study did not experience major health-related issues, such as skin rashes, skin ulceration, skin swelling, or

respiratory diseases, at the time of this study. The most common hazard of reactive dyes is respiratory problems caused by inhaling dye particles. Sometimes this affects a person's immune system, and in extreme cases, this means that when the person inhales the dye again, their body can react negatively. This hazard or ailment is called respiratory sensitisation, and the associated symptoms may include itching, watery eyes, sneezing, and asthma symptoms such as coughing and wheezing (Health and Safety Executive). It has been established that the most prevalent health problems associated with dyeing and finishing processes arise from exposure to chemicals acting as irritants. Exposure to chemicals and irritants may cause skin irritation, itchy or blocked noses, sneezing and eye sores. Chemicals to which workers may be exposed include formaldehyde-based resins, ammonia, acetic acid, some shrink-resist chemicals, some optical whiteners, soda ash, caustic soda, and bleach. Certain reactive, vat and disperse dyes have also been recognised as skin sensitisers (Suna, Tewes, Luch and Pirow, 2020). Adeakin (2009) posited that skin diseases, such as allergic contact dermatitis, irritant dermatitis and inflammation of the mucous membrane, are associated with Adire production.

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary

The work was based on the evaluation of textile dyers' (local industry) knowledge of textile effluent treatment techniques in Itoku, Abeokuta South Local Government Area of Ogun State, Nigeria. The textile industry has become indispensable due to its fundamental and societal importance to human life, but its environmental impact remains a concern. Textile chemicals, such as dyes, printing pigments, additives, oxidising agents, and reducing agents, can be highly harmful to the body and the environment if used improperly. The prime focus of this study is to promote and maintain a safe and healthy environment by ensuring the highest level of environmental health and safety assistance for small-scale textile dyers and chemical suppliers within the study area. The study population comprised batik and tie-dye producers (i.e., local producers). Interviews and observations were used to collect relevant data. The collected data were analysed and presented. It was found that 100% of textile producers were Yoruba and produced manually, with the majority (88.2%) operating on a full-time basis and the scale of production moderate (83.6%). All respondents (100.0%) were aware of the dangers posed by textile effluent. The majority (90.0%) had good

knowledge that mixing hydrogen sulfide with caustic soda produces a poisonous gas. A series of health-related issues were recorded, including severe sneezing, feeling of suffocation, vomiting, and premature deliveries, which accounted for 30.0%, 26.4%, 20.0%, and 17.3%, respectively, of the health-related issues associated with textile effluent waste treatment in the environment. There is a moderate perception of textile effluent in the environment sampled. Chi-square analysis shows a significant relationship ($p < 0.05$) between sex ($\chi^2 = 5.205$), religion ($\chi^2 = 4.417$), educational level ($\chi^2 = 7.146$), nature of work ($\chi^2 = 10.110$), and **perception of textile effluent in the environment**. The correlation result shows a positive, significant relationship ($p < 0.05$) between knowledge ($r = 0.781$) and perceptions of textile effluent in the environment. The study concluded that vital input to the economic decision-making process for a long-term, sustainable vocational/occupational health policy reform programme, particularly for artisans in both rural and urban areas, with a view to reducing occupational illnesses. It is therefore recommended that, to a very large extent, the government remain a major stakeholder in the provision of certain environmental goods and in providing guidelines to ensure strict compliance with environmental rules.

Conclusion

The general conclusion from this is that various health related issues exist in resist dyed fabric production across the study area even though some of the common illnesses are not noticed in the location, which are as a result of regular contact with synthetic dyes and chemicals which have resulted to occupational health hazards such as dermatitis, hitching, cough, respiratory diseases such as cough, catarrh, asthma, sneezing. No doubt attempts to prevent or stop production of the 'Adire' business would be seriously resisted by the people, despite the environmental issues associated with the indigenous textile industry. The study clearly indicates that although the majority of respondents knew about occupational hazards, regardless of the nature of the occupation they were engaged in, their attitude toward improving the work environment was positive. However, because there is no provision at the worksite, they are unable to practice. Making workers aware of the occupational hazards and motivating them to use PPE while at work is the need of the hour.

Recommendation

To save the environment and the health of citizens, governments at all levels in

Nigeria and other countries where similar results may be achieved are called upon to reinvigorate their regulatory agencies to enable them to discharge their oversight functions effectively. The activities of the local tie-and-dye (Adire) business in Nigeria should be regulated to curb the discharge of untreated, contaminant-laden wastewater into the environment.

Public education is necessary to address the knowledge gap revealed in the study. Therefore, education programs should be organised to improve knowledge of the effects of dyes and chemicals, and they should focus mainly on increasing people's awareness of the importance of using PPE at work.

Local government authorities should, through the mass media such as state radio stations, state press, etc., raise people's awareness and knowledge, particularly about the craft, not only the harmful effects of chemicals, but also other health information.

Besides, basic knowledge of the benefits of using PPE to protect traditional resist fabric craftsmen during their work should also be provided to them. Free publishing materials on education, training, and specific occupational health information written in local dialects should be offered.

Stakeholders in the indigenous 'Adire' textile industry should be educated on methods to protect against and prevent hazards during production.

Ethical considerations must evolve to protect the environment from the improper disposal of harmful waste. Available streams and nearby water bodies must be avoided during disposal under ethical means.

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