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Treatment of Solubilized Vat Dye to Cope With the Competitive Market in the Field of Dyeing Technology

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Abstract: In this study Anthrasol Blue IBC dye (solubilized vat dye) was prepared to be interact with environmental conditions as sunlight to develop the color, this mean it could back to life again in another usage, it will be used in garments, art boards, artistic works, it is easy to control and have an artistic view to get light and dark shades. On the other side there is a similar commercial dye in the market called INKODYE (blue), and it is a soluble vat dye that uses light rather than oxygen to fix the dye.

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1. Introduction

The differences between a classical and high added value product are numerous; production process may be far technologically more demanding, number of functionalities may be increased significantly, technical applicability may be greater and finally the greatest difference may be between the price of production and that of final product., these dyes have wide application in various fields. In textile it is used for various garments like T- Shirts, security- badges and almost in garments of all sorts depending upon its usage. [9]

Inkodyes blue are true dyes, not a fabric paints. A dye itself attaches to the fabric by a glue like a binder. These dyes are developed by sunlight instead of being applied in an oxygen-free bath and developed by exposure to oxygen, [11] also the Anthrasol Blue IBC dye in this study developed by sunlight instead of an oxygen-free bath then exposure to oxygen. [12]

1.1. Soluble vat dyes

Vat dyes are insoluble in water and leuco vat is not a stable product, however leuco esters of vat dyes are stable and readily soluble in water, leuco ester of vat dyes are available in powder form known as Indigosol Dyes or solubilized vat dyes. Being water soluble these dyes are readily applied to cellulosic fibers. [12] The other form Inkodyes are available in solution form and it also water soluble. [11]

2. Materials:

2.1. Dyestuffs

2.1.1. Anthrasol Blue IBC: solubilized vat dye (Dystar company), in the soluble form it behave like direct dyes and hence can dye cotton fibers. On exposure to sunlight this soluble leuco form of the dye gets converted to colored insoluble form of the dye after been treated with compound sensitive to light (Azo: P.V.A) solution. [8]

2.1.2.Inko-dyes (blue): light-sensitive vat dyes (lumi company), The Inko-dyes are commercial Vat dyes, but instead of being applied on oxygen free bath and then locking in fabric by exposure to oxygen, it is developed in light. it attached to the fabric by a glue like a binder, Inkodyes is water based and requires no additional solvents for development or clean up. [13]

2.2. Chemicals [8]

2.2.1. Soduim Carbonate (Na_2Co_3)
2.2.2. Poly vinyl alcohol (P.V.A)
2.2.3. Azo compound
2.2.4. Nitrite sodium ($NaNo_2$)
2.2.5. Zinc formaldhyde
2.2.6. Sulfuric acid (10%) (H_2So_4)

2.3. Cotton fabric:

Long staple Egyptian cotton variety Giza 86. Giza 86 was measured in Cotton Research Institute (CRI) labs by HVI spectrum instrument, the fiber properties of this cotton material were presented in table (1). The cotton samples were spun to 20s, with twist multiplier 4.0 T. M. using the olfil open-end (OE) machine, this spinning technique was carried out according to the conventional method used at the experimental spinning mill. All of those yarn produced under controlled atmospheric conditions of 20◦C±2 temperature and 65%±2% Relative humidity. [10]

3. Experimental Techniques

3.1. Dyeing process

3.1.1. Anthrasol Blue IBC:

Immerse the sample in the dye bath (L.R 1:20) (100 ml water, 5gm sodium carbonate, 5gm soluble

vat dye and 5gm nitrite soduim) raise the temperature to 60 -70 ˚c for 45 min, extract the sample from the dye then immerse it in Azo and P.V.A (1:10) solution to make the dye developed by sunlight and get dark shades, let it in presence of direct sunlight for 20 min.

Washing off: Dyed samples were rinsed with zinc formaldehyde (5g/L) then immerse in sulfuric acid (10%) for 1 min to get dark shades, soaped with a solution containing 5g/l nonionic detergent for 1 min, after wash the samples left it air dried. [8]

Table 1-Cotton fiber properties of the studied variety (G86)

Cotton	Color	HVI measurements						Micromat measurements		
		Values of color attributes		Fiber length		Fiber strength & elongation %		Fiber fineness & maturity		
		Brightness (Rd%)	Yellowness (+b)	UHM (mm.)	Uniformity Index (%)	Strength (g/tex)	Elongation (%)	Micronaire value	Maturity (%)	Fineness (mtex)
G86	White	77.0	8.9	33.5	87.9	45	7	4.5	89	162

3.1.2. Inkodye:

Immerse the fabric in the dye, keep the samples in presence of direct sunlight for 30 min.

Washing off:

Dyed samples were thoroughly rinsed with running cold water then soaped with a solution containing 5g/l nonionic detergent at 40 c for 15 min, after wash the samples left it air dried. [14]

3.2 Testing processes

The samples were tested after dyed to see the effect of the factors in dyeing and the effect on its properties, the samples were prepared in standard atmosphere for 24 hours before performing tests: Temperature (20± 2 ˚C) and Humidity % (65 ± 2 %). [1]

The factors were: 1. Color measurements of the dyed cotton samples with Anthrasol Blue IBC (K\S) and Inkodye.

Comparison between Anthrasol IBC dye and Inkodye in:

1. Color measurements of the dyed cotton samples (K\S)
1.1. Effect of temperature
1.2. Effect of concentration of salt (sodium carbonate) in the dyeing bath
1.3. Effect of the time of dyeing
1.4. Effect of nitrite sodium in the dyeing bath
1.5. Effect of the time exposing to sunlight
1.6. Effect of time exposing to Ultra Violet light
1.7. Effect of different concentration of the dye

2. Fastness properties

2.1. Color fastness to laundering
2.2. Color fastness to water
2.3. Color fastness to seawater
2.4. Color fastness to perspiration
2.5. Color fastness to crocking
2.6. Color fastness to light
2.7. PH value

3. Results and discussion

1. Color measurements of the dyed cotton samples (K\S)

1.1. Effect of temperature

Anthrasol IBC dye:

The results obtained the best condition at 70◦c for the dyeing bath. [8]

Inkodye:

There is no need for dyeing bath, the fiber immersed in the dye in room temperature or it can be applied by coating and achieve the same result as Anthrasol IBC dye.

1.2. Effect of concentration of salt (sodium carbonate)

Anthrasol IBC dye:

The results obtained the best condition for adding 5gm sodium carbonate in the dyeing bath for 100 ml water. [8]

Inkodye:

There is no need for dyeing bath and using salt, it is already liquid and no need for additional chemicals.

1.3. Effect of the time of dyeing

Anthrasol IBC dye:

The results obtained the best condition 45 min for dyeing. [8]

Inkodye:

Only need to immerse until the fiber absorb the dye.

1.4. Effect of nitrite sodium in the dyeing bath

Anthrasol IBC dye:

The results obtained the best condition for adding 5gm nitrite sodium in the dyeing bath for 100 ml water. [8]

Inkodye:

There is no need for dyeing bath and using nitrite sodium, it is already liquid and no need for additional chemicals.

1.5. Effect of time exposing to sunlight

Table (2) shows the color strength (K\S), the results revealed that inkodye interact to sunlight with high values for K\S, also Anthrasol IBC interact and developed by sunlight and gives reasonable values for (K\S)

1.6. Effect of time exposing to Ultra Violet light

Table (3) shows the color strength (K\S), the results revealed that inkodye interact to U-V with high values for K\S, also Anthrasol Ibc interact and developed by U-V but in pale shade comapriso to sunlight and gives reasonable values for (K\S).

Table (2): Effect of time exposing to sunlight (Anthrasol IBC vs. Inkodye)

Time	Anthrasol IBC	Inkodye
10 min	2.95	2.26
20 min	3.25	5.18
30 min	3.21	6.41
40 min	3.21	6.41

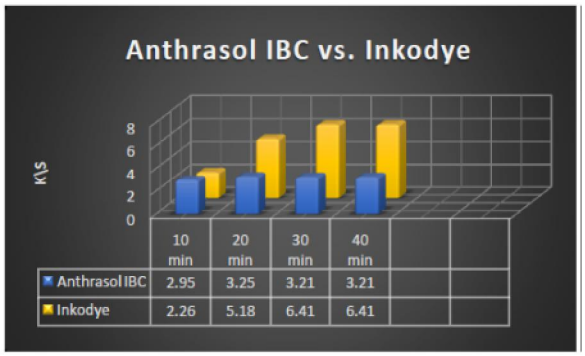

Figure (1): Anthrasol IBC vs. Inkodye with Sunlight

Table (3): Effect of the time exposing to Ultra Violet light (Anthrasol IBC vs. Inkodye)

Time	Anthrasol IBC	Inkodye
10 min	1.0	3.17
20 min	1.5	3.39
30 min	1.43	3.40
40 min	1.40	3.40

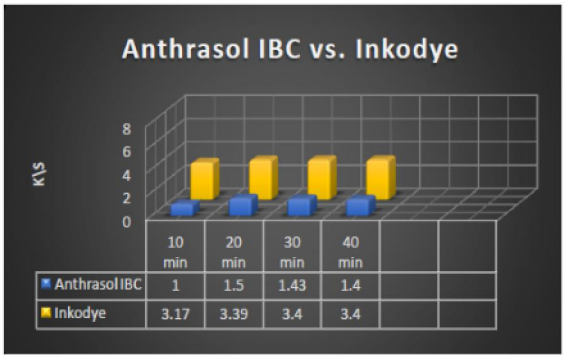

Figure (2): Anthrasol IBC vs. Inkodye with U-V

1.7. Effect of different concentration of the dye

Anthrasol IBC dye:

The results obtained the best condition at 5gm of dye for 100 ml water and liquor ratio 1:20. The other concentrations (1, 3) gm gave a pale shades. [8]

Inkodye:

The real concentration of the dye is anymonous because it is commercial but it is water based so can be diluted.

2. Fastness properties

2.1. Color fastness to laundering [1]

It can be seen in table (4) that the laundering fastness gave in color change similar grads between 4 and 4.5. The staining on the multi-fiber also similar to each other expect for nylon and cotton in Anthrasol IBC gave 3.5 but in Inkodye 4.5 out of 5, the fastness showed such a good performance due to the self-staining 4.5.

Table (4): Color fastness to laundering (Anthrasol IBC vs. Inkodye)

Laundering at 40◦c	Anthrasol IBC	Inkodye
Color change	4	4.5
Staining on		
Wool	4.5	5
Acrylic	5	5
Silk	4.5	5
Nylon	3.5	4.5
Cotton	3.5	4.5
Acetate	5	5
Self-Staining	4.5	4.5

2.2. Color fastness to Water [2]

It can be seen in table (5) that the water fastness gave in color change similar grads between 4.5 and 5. The staining on the multi-fiber also similar to each other between 4.5 and 5.

2.3. Color fastness to Seawater [3]

The results show in table (6) that the seawater fastness gave in color change similar grads between

4.5 and 5. The staining on the multi-fiber also similar to each other between 4.5 and 5.

2.4. Color fastness to Acidic Perspiration [4]

It can be seen in table (7) that the seawater fastness gave in color change similar grads between 4.5 and 5. The staining on the multi-fiber also similar to each other between 4.5 and 5.

2.5. Color fastness to Crocking [5]

It can be seen in table (8) that the crocking fastness gave similar grads between 4.5 and 5 between Anthrasol IBC dye and Inkodye. it is a great value due to vat dyes.

2.6. Color fastness to light [6]

It can be seen in table (9) that the light fastness gave similar grads between 4 and 4.5 between Anthrasol IBC dye and Inkodye.

2.7. pH value [7]

It can be seen in table (10) that the pH value better in Anthrasol IBC dye and more safe for human health.

Table (5) Color fastness to Water (Anthrasol IBC vs. Inkodye)

Color Fastness to Water	Anthrasol IBC	Inkodye
Color change	4.5	5
Staining on		
Wool	4.5	4.5
Acrylic	5	5
Silk	4.5	4.5
Nylon	4.5	4.5
Cotton	5	4.5
Acetate	5	5
Self-Staining	N\A	N\A

Table (6): Color fastness to Seawater (Anthrasol IBC vs. Inkodye)

Color Fastness to Seawater	Anthrasol IBC	Inkodye
Color change	4.5	5
Staining on		
Wool	4.5	4.5
Acrylic	4.5	4.5
Silk	4.5	4.5
Nylon	5	5
Cotton	4.5	5
Acetate	5	5
Self-Staining	N\A	N\A

Table (7): Color fastness to Acidic Prespiration (Anthrasol IBC vs. Inkodye)

Color Fastness to Perspiration Acidic	Anthrasol IBC	Inkodye
Color change	4.5	5
Staining on		
Wool	4.5	4.5
Acrylic	4.5	4.5
Silk	4.5	4.5
Nylon	5	4.5
Cotton	4.5	4.5
Acetate	5	5
Self-Staining	N\A	N\A

Table (8): Color fastness to Crocking (Anthrasol IBC vs. Inkodye)

Color fastness to Crocking	Anthrasol IBC	Inkodye
Dry	4.5	5
Wet	4	4.5

Table (9): Color fastness to Light (Anthrasol IBC vs. Inkodye)

Color fastness to light	Anthrasol IBC	Inkodye
Color Change	4	4.5

Table (10) pH value (Anthrasol IBC vs. Inkodye)

pH value	Anthrasol IBC	Inkodye
	6.75	8

Conclusion

In this study Inkodyes were found in the market as a commercial solubilized vat dye in a solution form that developed by sunlight and these dyes have wide application in various fields. In textile it is used for various garments like T- Shirts, security- badges and almost in garments of all sorts depending upon its usage. On the other hand the Anthrasol IBC solubilized vat dye in a powder form used as ordinary vat dye that needs oxidization process to develop the color, but here it was treated to develop the color by sun light and get different and deep shades. Trying to be similar to the commercial dye to be competitive in the market and use it for different usages to provide individual designs facilitates everyday consumer needs. From the previous results proved that the results much more similar in color fastness (Laundering, Water, Seawater, Acidic perspiration, Light and crocking), however there is a difference in pH value and components of dyeing bath based on the attempt to make Anthrasol IBC dye reach to the commercial components dye (Inkodye).

References:

1. ATCC Test method 8-2013.
2. AATCC Test method 15-2013.
3. AATCC test method 16-2011.
4. AATCC Test method 61-2013.
5. ATCC Test method 81-2012.
6. ATCC Test method 106-2013.
7. AATCC Test method 107-2013.
8. Assist. Prof. Dr/Amr Emad El Dien Alam, Designer / Safaa Taha Moustafa, 'New technique using light for fixing solubilized vat dyes ", Architecture, Art & Humanistic Scince Magazine, Twelve issue, pp.17-26, (2018).
9. Peter Bamfield, "Chromic Phenomena (The technology Applications of color chemistry)" (2011).
10. The Cotton Research Institute Quality Test Corp, Cotton Research Institute, Agriculture Research Center. Giza, (2006).
11. Toshiaki Aoai; Todayoshikokubo, "Light – sensitive composition", (1996).
12. J. R. Aspland, "Vat dyes and their Application", school of textiles, Clemson University, vol.24, (1998).
13. T. L. Dawson and C. J. Hawkyard, "Coloration", Rev. Prog, (2006).
14. http://www.inkodye.com/guides/sunfold.

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