Reactive Dye Experiment

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Abstract:

If one would soak textiles in a reactive dye then the natural textiles would have the greatest affinity to each of the dye bath. A fiber reactive dye is defined as dye molecules form a covalent bond with the fiber molecules. Washing cannot break dye-fabric molecule; it is permanent. It is expected that cellulose based fibers would have the greatest affinity for fiber reactive dyes due to the multitude of OH sites. Our variables used was with various assistants that were evaluate their effectiveness. One can conclude that there is a strong affinity to of reactive dye to natural textiles.

Introduction:

The purpose of the experiment is to discover if one would soak textiles in a reactive dye then natural textiles would have the greatest affinity to each of the dye bath?

The component of salt acts as an electrolyte that decreases the solubility of the dye. This causes the dye molecules to move round and seek easier suitable dye-binding sites.

The second component used was Urea. Urea is used in two ways; to dissolve more dye in a given volume for the

strongest of colors and to serve as a water-attractor to help keep fabric damp long enough for the reaction to occur.

Hydroxyl part of the cellulose interacts with the dichlorotriazine part of the reactive dye molecule. The H bonds with the Cl, creating the rule of octet. The cellulose molecule, via oxygen, replaces the Cl on the dichlorotriazine of the dye molecule.

Apparatus:

- Safety Glasses
- Rubber Gloves
- Plastic Apron
- Measuring Gloves
- Scales
- Glass Containers
- Glass Stirring Rods
- Beakers
- Hot Plates
- Permanent Black Ink Pens
- Needles and Threads
- 3 Full Swatch set of Fabric Samples
    1. Cotton
    2. Silk

3. Wool
4. Linen
5. Bamboo
6. Rayon
7. Jute
8. Nylon
9. Polyester
10. 64% Nylon, 32% Polyester, 4% Spandex

- Dyes, Soda Ash, Salt, and Urea
- pH Meters
- Wooden Clothespins
- Drying Racks
- Newspapers
- Thermometers

Procedures:

Preparing The Liquid Dye Concentrate for Each Color:

Created liquid dye concentrate in fume hood. Used warm water (30 degrees Celsius) that dissolved the urea. Added dye powder.

Preparing Soda Solution (Used for Pre-Soak):

Dissolved soda ash in warm water (30 degrees Celsius). The recipe is as follows: Soda Ash – 18 grams & Water: 800 mL

Sample Set 1:

Pre-soaked swatch set with warm soda ash and water solution for 30 minutes at 30 degrees Celsius. The formula for this dye bath is as follows: water – 120 mL, urea – 7 grams, dye – 1 gram. Placed one swatch set in this beaker. Stirred occasionally for 30 minutes. Removed the swatches from the beaker. Rinsed swatches thoroughly with soap and water.

Sample Set 2:

Pre-soaked the fabric with warm soda ash and water solution for 30 minutes at 30 degrees Celsius. The formula for this dye bath is as follows: water – 120 mL, non-iodized salt – 16 grams, dye – 1 gram. Placed one swatch set in this beaker. Stirred occasionally for 30 minutes. Removed

the swatches from the beaker. Rinsed them with soap and water.

Sample Set 3:

Pre-soaked the fabric with warm soda ash and water solution for 30 minutes at 30 degrees Celsius. The formula for this dye bath is as follows:water – 120 mL, dye – 1 gram. Placed one swatch set in this beaker. Stirred occasionally for 30 minutes. Removed the swatches from the beaker. Rinsed them with soap and water.

Determining HSB and RGB:

Took dyed swatches of both sets and compared it to the HSB/RGB chart at http://www.colorpicker.com/. Recorded the results to data chart.

Results/ Data:

Visual Assessment: Best Salt + Dye

1. Silk

2. Jute
3. Rayon
4. Bamboo
5. Cotton
6. Linen
7. Wool
8. Nylon
9. 64% Nylon, 32% Polyester, 4% Spandex
10. Polyester

Visual Assessment: Best Dye

1. Silk
2. Rayon
3. Bamboo
4. Jute
5. Cotton
6. Linen
7. Wool
8. 64% Nylon, 32% Polyester, 4% Spandex
9. Polyester
10. Nylon

Visual Assessment: Best Urea + Dye

1. Silk
2. Rayon
3. Jute
4. Bamboo
5. Cotton
6. Linen
7. Wool
8. 64% Nylon, 32% Polyester, 4% Spandex
9. Polyester
10. Nylon

CHEMISTRY AND ART:
TEXTILES AND DYES

LABORATORY EXERCISE 4: REACTIVE DYES

~~18g~~ of Soda ash → 300 mL water; 30°C
~~&~~ Soak all 3 swatch set

Beakers: 120mL hot H_2O → 500 mL H_2O

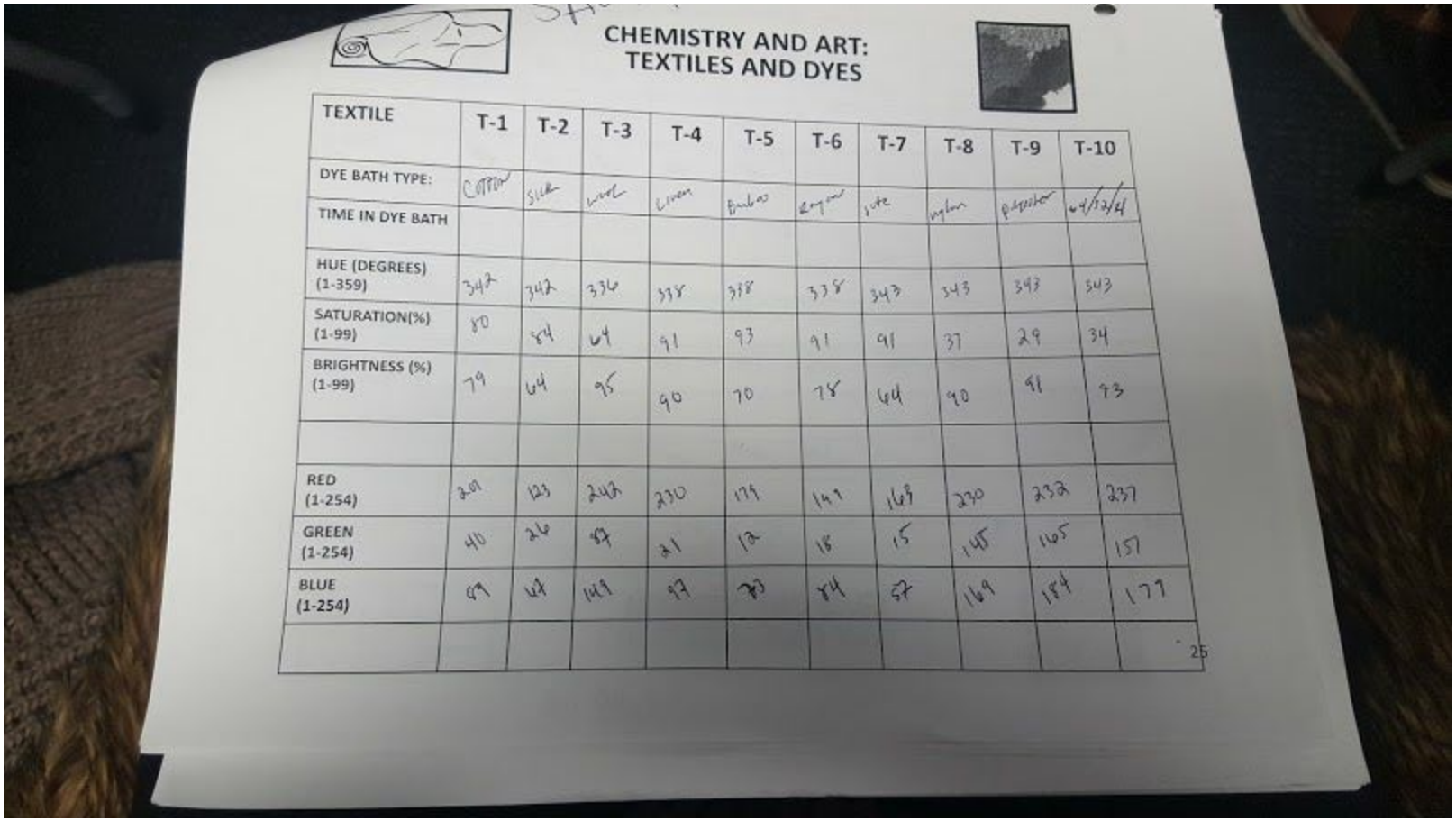
1. Swatch just dye & water
2. Swatch dye & salt & water
3. Swatch dye & Urea & water

4:51pm put swatches in beaker

DYE (DIE)

CHEMISTRY AND ART: TEXTILES AND DYES

TEXTILE	T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	T-9	T-10
DYE BATH TYPE:	cotton	silk	wool	Linen	Bamboo	Rayon	jute	nylon	Polyester	[illegible]
TIME IN DYE BATH										
HUE (DEGREES) (1-359)	328	356	343	343	343	332	332	321	321	321
SATURATION(%) (1-99)	54	92	44	68	77	96	77	29	38	18
BRIGHTNESS (%) (1-99)	87	59	97	72	76	76	50	97	98	99
	2									
RED (1-254)	222	150	247	189	194	194	204	247	250	252
GREEN (1-254)	35	12	139	60	45	8	47	176	155	207
BLUE (1-254)	135	21	149	47	47	75	130	232	[illegible]	232



CHEMISTRY AND ART: TEXTILES AND DYES

TEXTILE	T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	T-9	T-10
DYE BATH TYPE:	cotton	silk	wool	linen	Bamboo	Rayon	jute	nylon	polyester	4/12/24
TIME IN DYE BATH										
HUE (DEGREES) (1-359)	342	342	336	338	338	338	343	343	343	343
SATURATION(%) (1-99)	80	84	64	91	93	91	91	37	29	34
BRIGHTNESS (%) (1-99)	79	64	95	90	70	78	64	90	91	93
RED (1-254)	209	123	243	230	179	149	168	230	232	237
GREEN (1-254)	40	26	97	81	12	18	15	145	165	157
BLUE (1-254)	97	47	149	97	83	84	57	169	184	177

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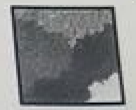
CHEMISTRY AND ART: TEXTILES AND DYES



TEXTILE	T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	T-9	T-10
DYE BATH TYPE:	cotton	silk	wool	linen	Bamboo	Rayon	jute	nylon	polyester	[illegible]
TIME IN DYE BATH										
HUE (DEGREES) (1-359)	352	352	352	345	348	345	345	345	345	346
SATURATION(%) (1-99)	54	86	42	73	80	91	88	78	34	33
BRIGHTNESS (%) (1-99)	91	68	100	94	92	53	80	97	98	92
RED (1-254)	232	173	255	240	235	219	204	247	250	235
GREEN (1-254)	167	24	148	65	47	19	77	159	160	152
BLUE (1-254)	123	44	162	108	94	62	79	177	188	175

SALT

Sam S

1. 100% COTTON

2. 100% SILK

3. 100% WOOL

4. 100% LINEN

5. 100% BAMBOO

6. 100% RAYON

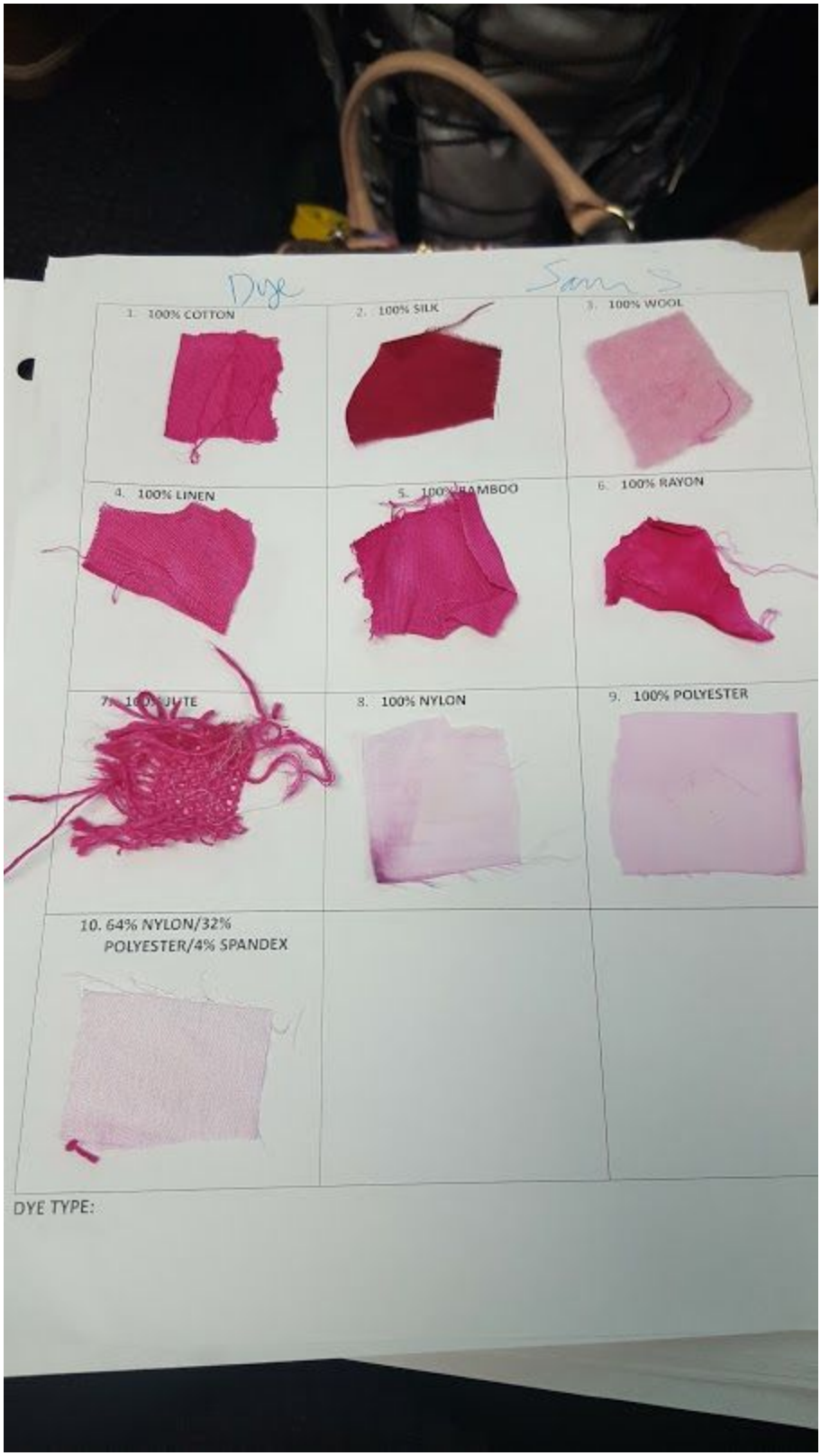
7. 100% JUTE

8. 100% NYLON

9. 100% POLYESTER

10. 64% NYLON/32% POLYESTER/4% SPANDEX

YE TYPE:


Dye
Sam 3
1. 100% COTTON
2. 100% SILK
3. 100% WOOL
4. 100% LINEN
5. 100% BAMBOO
6. 100% RAYON
8. 100% NYLON
9. 100% POLYESTER
10. 64% NYLON/32% POLYESTER/4% SPANDEX
DYE TYPE:

Vnea Sam S.

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5. 100% BAMBOO

6. 100% RAYON

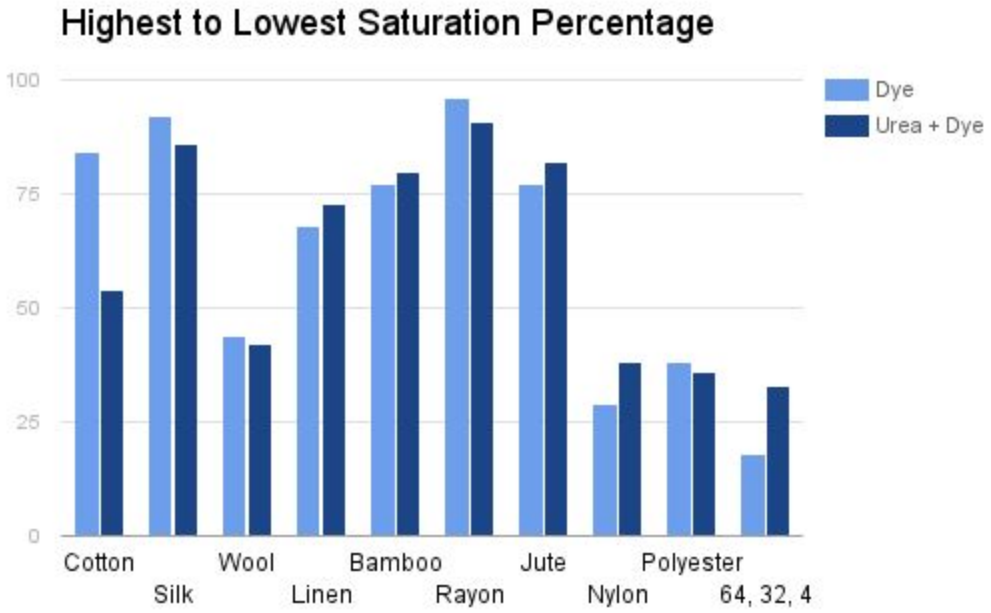
7. 100% JUTE

8. 100% NYLON

9. 100% POLYESTER

10. 64% NYLON/32% [illegible]SPANDEX

YPE:



Discussion/ Analysis:

Interpret your data:

From referencing the *Highest to Lowest Saturation Percentage,* column graph,that the natural textiles had the greatest affinity to the reactive dye. This is seen in especially Cotton, Silk, Linen, and Bamboo with the highest saturation.

From referencing the *Visual Assessment* portions of the data, Silk was ranked first with all three lab variables. As well, polyester was always in the bottom two.

Draw Conclusion:

The reactive lab did validate my hypothesis that if one would soak textiles in a reactive dye then the natural textiles would have the greatest affinity to each of the dye bath. The experiment is validated because from the data taken, on can conclude that, natural textiles had the overall best averages, saturation, and most appealing to the eye which is scientifically backed by chemical process of dyeing. Chemical process that was demonstrated was when the hydroxyl part of the cellulose interacted with the dichlorotriazine part of the reactive dye molecule. The H bonds with the Cl, declaring that the rule of octet was fully established. The cellulose molecule, via the oxygen, replaces the Cl on the dichlorotriazine of the dye molecule.

Sources of Error:

An error that happened was when comparing our textiles samples to a computer monitor while determining HSB and RGB. As well, in some areas, there were concentrated spots of dye on our swatches, especially on polyester.

Possible Improvements:

If we did this lab again, I would turn my computer on the highest brightness setting to get a clear view of the screen while determining the data of the swatches. As well, conduct the data in a luminescent room. I would also be sure to sure the swatched evenly while in the dye bath and manipulate in such a way so even dispersement can take place with the reactive dye.

Conclusion: A Final Comment

I concluded that there is a strong affinity to of reactive dye to natural textiles, especially with cellulose based fabric. Although there were minor set backs with the sources of error that occurred, I still draw the conclusion that salt and dye had overall the best affinity to the textiles compared to urea.