Substantive Dye Experiment With Annatto Seed, Madder Root, and Black Walnut Shell

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Abstract:

If one would stir textiles in substantive dyes then it will affect the affinity if the time and temperature is fixed. Dyeing processes that included agitation had resulted in higher affinity between the fibers and the dye molecules this is due to agitation that would increase the rate of dye brought by the dye to the surface of the fiber. One can conclude that there is a stronger affinity to natural textiles.

Introduction:

The purpose of the experiment is to discover if one would stir textiles in substantive dyes, then would it affect the affinity if the time and temperature is fixed?

The affinity of a dye on a textile depends on the chemical structure of the dye being used; annatto, madder, and black walnut along with the textile molecule and the interaction between them.

Substantive dyes

Apparatus:

- Safety Glasses
- Rubber Gloves

- Plastic Apron
- Measuring Containers
- Digital Scales
- Digital pH meters
- Glass Beakers
- Permanent Black ink Pens
- Fabric Samples (Two swatches of each type)
    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
- Stirring Rods
- Wooden Clothespins
- Drying Racks
- Newspaper
- Water
- Madder 150g
- Annatto 150g
- Black Walnut 150g

Procedures:

Creating Annatto Dye Bath:

Soaked Annatto seeds overnight. Poured 500ml room temperature water into slow cooker with four ounces of seeds. Originally set the cooker to hot, once hot reduce

the setting to medium. Took contents out and and put into glass container, allowed to reach room temperature.

Creating Madder Dye Bath:
Took soaked roots and blended with water. Poured the grounded roots and water into a slow cooker till ¾ full. Turned cooker to low heat to simmer for 4 hours.

Creating Black Walnut Dye Bath:
Filled slow cooker with ½ gallon of water. Placed 4oz. of crushed walnut husks in slow cooker. Simmered husk for 6 hours.

Dying Sequence:

Presoaked swatches in warm water for 1 hour. Rung out excessive water in swatches. Poured dye vat into dye bath at 500ml, then added 200ml of water into dye baths. Placed a swatch set in each dye bath. Manipulated individual swatches. Stirred one dye bath 5 minutes every ten minutes counter clockwise for 1 hour and 30 minutes. Removed swatch sets. Rinsed efficiently. Laided on newspaper. Hung up swatches on drying rack.

Repeat above steps for annatto, madder, and black walnut.

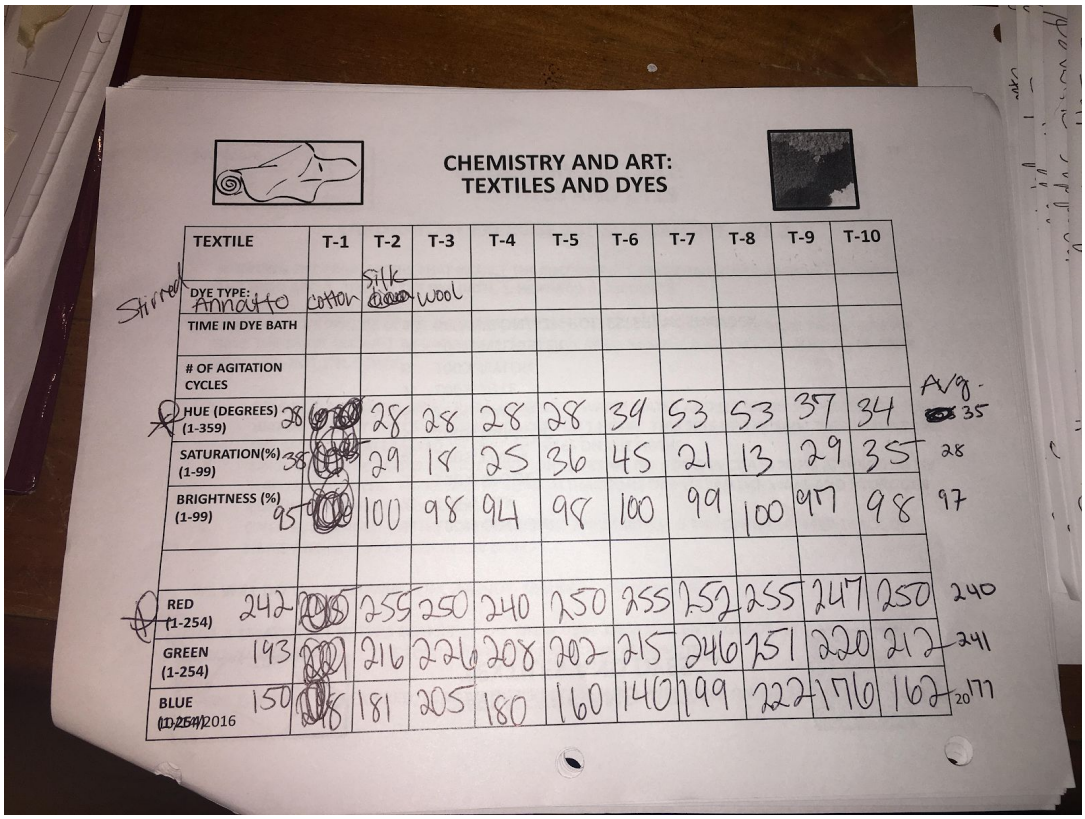


Determining HSB and RGB:

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:

Data Table for Annatto Stirred:



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 TYPE: Annatto (Stirred)	cotton	silk	wool								
TIME IN DYE BATH											
# OF AGITATION CYCLES											
HUE (DEGREES) (1-359)	28	28	28	28	28	34	53	53	37	34	Avg. 35
SATURATION(%) (1-99)	38	29	14	25	36	45	21	13	29	35	28
BRIGHTNESS (%) (1-99)	95	100	98	94	98	100	99	100	97	98	97
RED (1-254)	242	255	250	240	250	255	252	255	247	250	240
GREEN (1-254)	193	216	226	208	202	215	246	251	220	212	241
BLUE (1-254)	150	181	205	180	160	140	199	222	176	162	177

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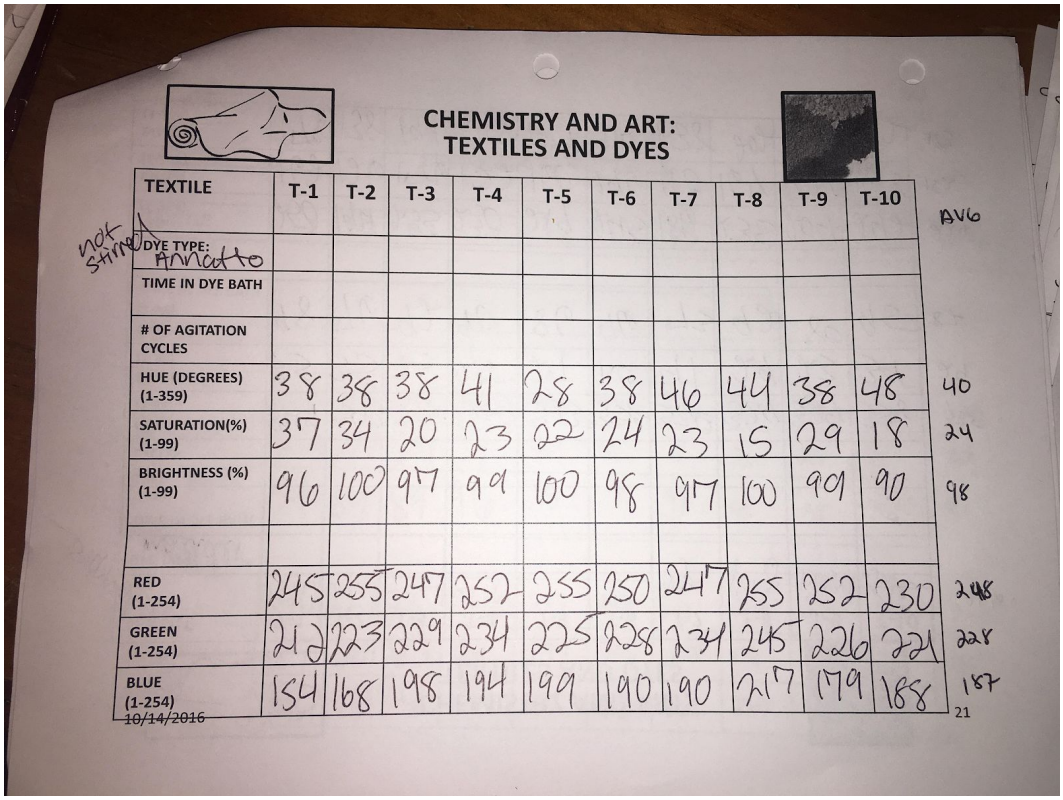
Data Table for Annatto Not Stirred:



CHEMISTRY AND ART: TEXTILES AND DYES

not stirred

TEXTILE	T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	T-9	T-10	AVG
DYE TYPE: Annatto											
TIME IN DYE BATH											
# OF AGITATION CYCLES											
HUE (DEGREES) (1-359)	38	38	38	41	28	38	46	44	38	48	40
SATURATION(%) (1-99)	37	34	20	23	22	24	23	15	29	18	24
BRIGHTNESS (%) (1-99)	96	100	97	99	100	98	97	100	99	90	98
RED (1-254)	245	255	247	252	255	250	247	255	252	230	248
GREEN (1-254)	21	223	229	234	225	228	234	245	226	221	228
BLUE (1-254)	154	168	198	194	199	190	190	217	179	188	187

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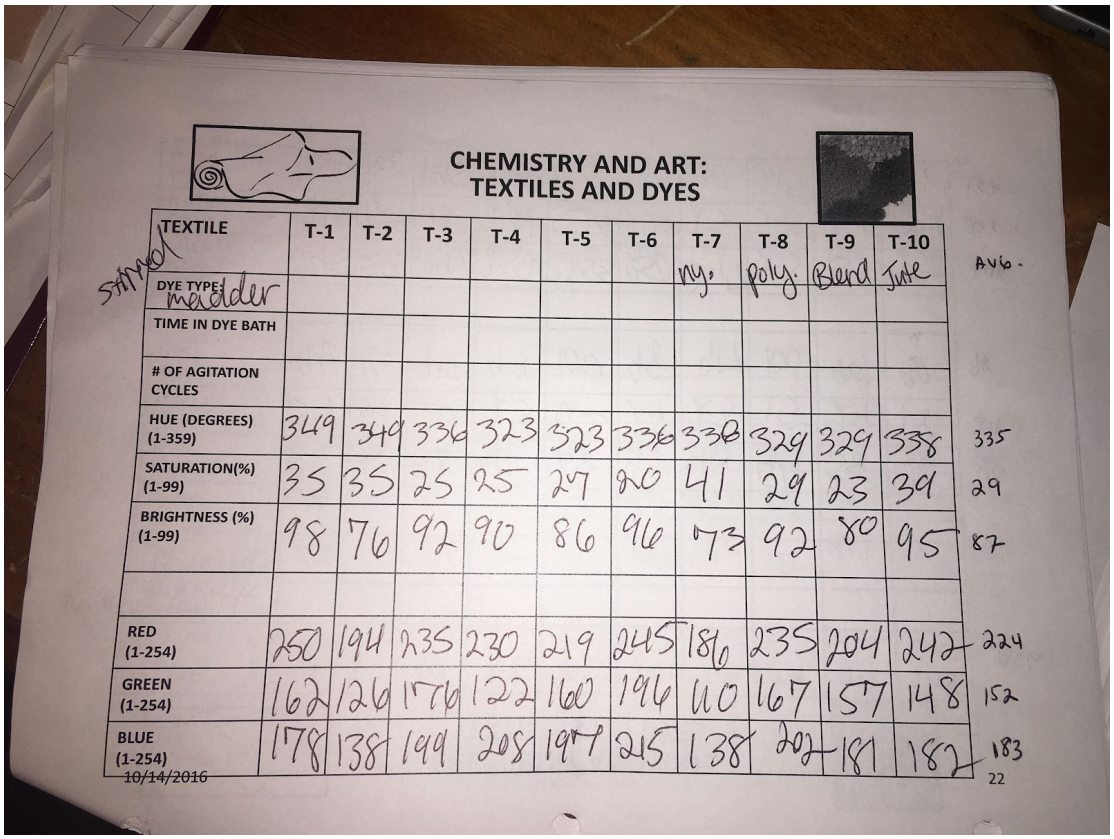
Data Table for Madder Stirred:



CHEMISTRY AND ART: TEXTILES AND DYES

TEXTILE (stirred)	T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	T-9	T-10	AVG.
DYE TYPE: madder							my.	poly.	Blend	Jute	
TIME IN DYE BATH											
# OF AGITATION CYCLES											
HUE (DEGREES) (1-359)	349	349	336	323	323	336	338	329	329	338	335
SATURATION(%) (1-99)	35	35	25	25	27	20	41	29	23	39	29
BRIGHTNESS (%) (1-99)	98	76	92	90	86	96	73	92	80	95	87
RED (1-254)	250	194	235	230	219	245	186	235	204	242	224
GREEN (1-254)	162	126	176	122	160	196	110	167	157	148	152
BLUE (1-254)	178	138	199	208	197	215	138	202	181	182	183

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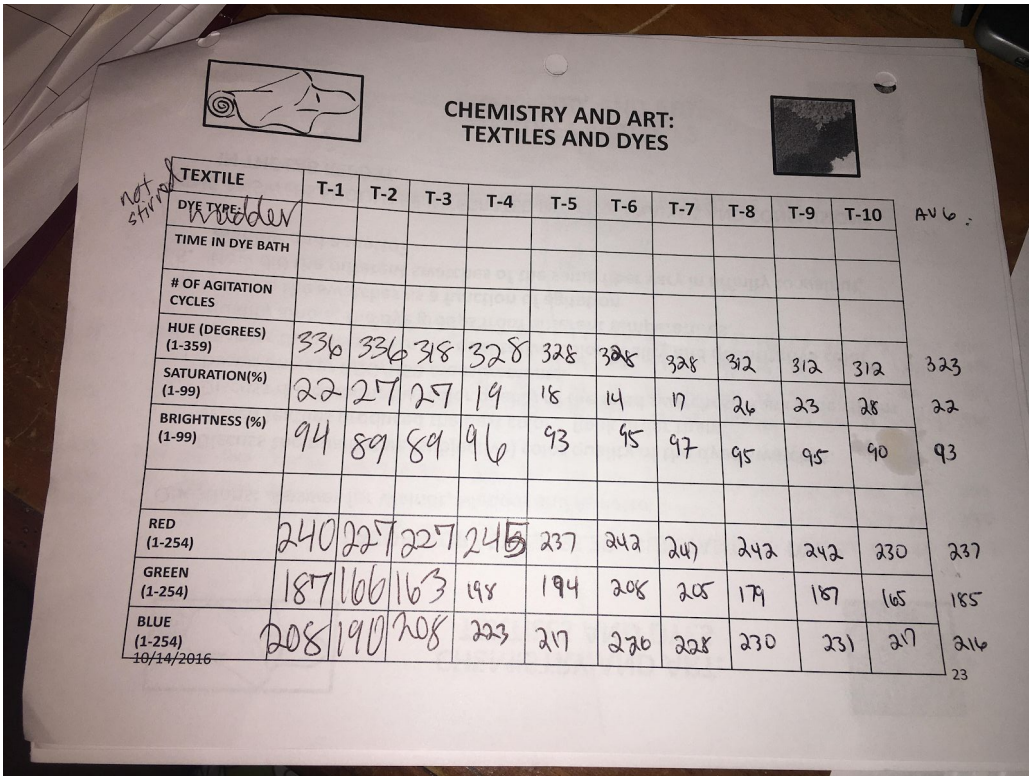
Data Table for Madder Not Stirred:



CHEMISTRY AND ART:
TEXTILES AND DYES

not stirred

TEXTILE	T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	T-9	T-10	AVG
DYE TYPE: Madder											
TIME IN DYE BATH											
# OF AGITATION CYCLES											
HUE (DEGREES) (1-359)	336	336	318	328	328	328	328	312	312	312	323
SATURATION(%) (1-99)	22	27	27	19	18	14	17	26	23	28	22
BRIGHTNESS (%) (1-99)	94	89	89	96	93	95	97	95	95	90	93
RED (1-254)	240	227	227	245	237	242	241	242	242	230	237
GREEN (1-254)	187	166	163	198	194	208	205	179	187	165	185
BLUE (1-254)	208	190	208	223	217	230	228	230	231	217	216

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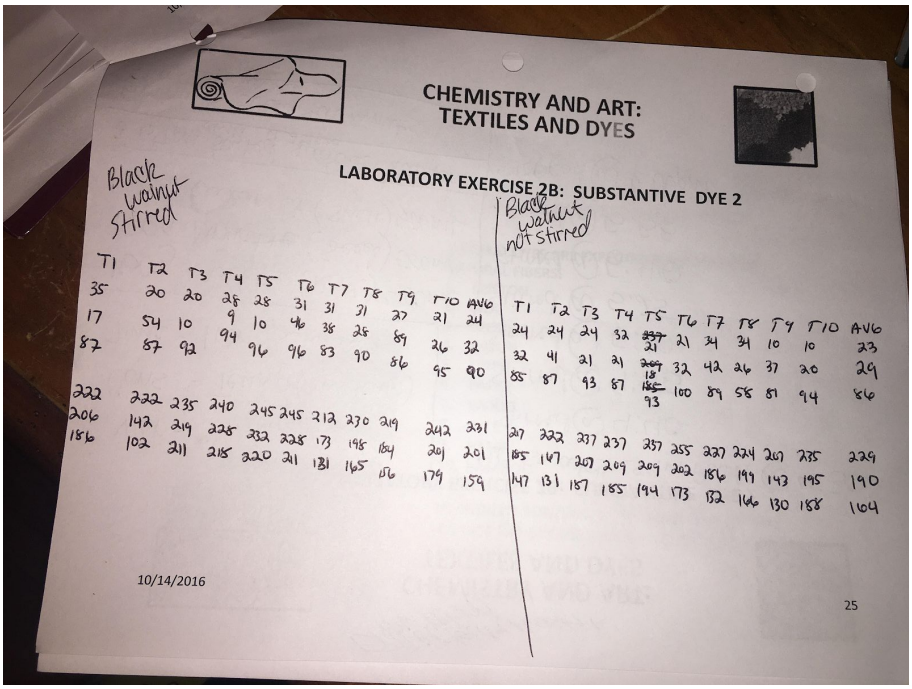
Data Table for Black Walnut Stirred and Not Stirred:



CHEMISTRY AND ART:
TEXTILES AND DYES

LABORATORY EXERCISE 2B: SUBSTANTIVE DYE 2

Black walnut stirred

T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	AVG
35	20	20	25	25	31	31	31	27	21	24
17	54	10	9	10	46	38	25	89	26	32
87	57	92	94	96	96	83	90	86	95	90
222	222	235	240	245	245	212	230	219	242	231
206	142	219	225	232	228	173	195	184	201	201
186	102	211	215	220	211	131	165	156	179	159

Black walnut not stirred

T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	AVG
24	24	24	32	~~237~~ 21	21	34	34	10	10	23
32	41	21	21	~~209~~ 18	32	42	26	37	20	29
85	87	93	87	~~185~~ 93	100	89	58	81	94	86
217	222	237	237	237	255	227	224	267	235	229
185	147	207	209	209	202	186	199	143	195	190
147	131	187	185	194	173	182	166	130	188	164

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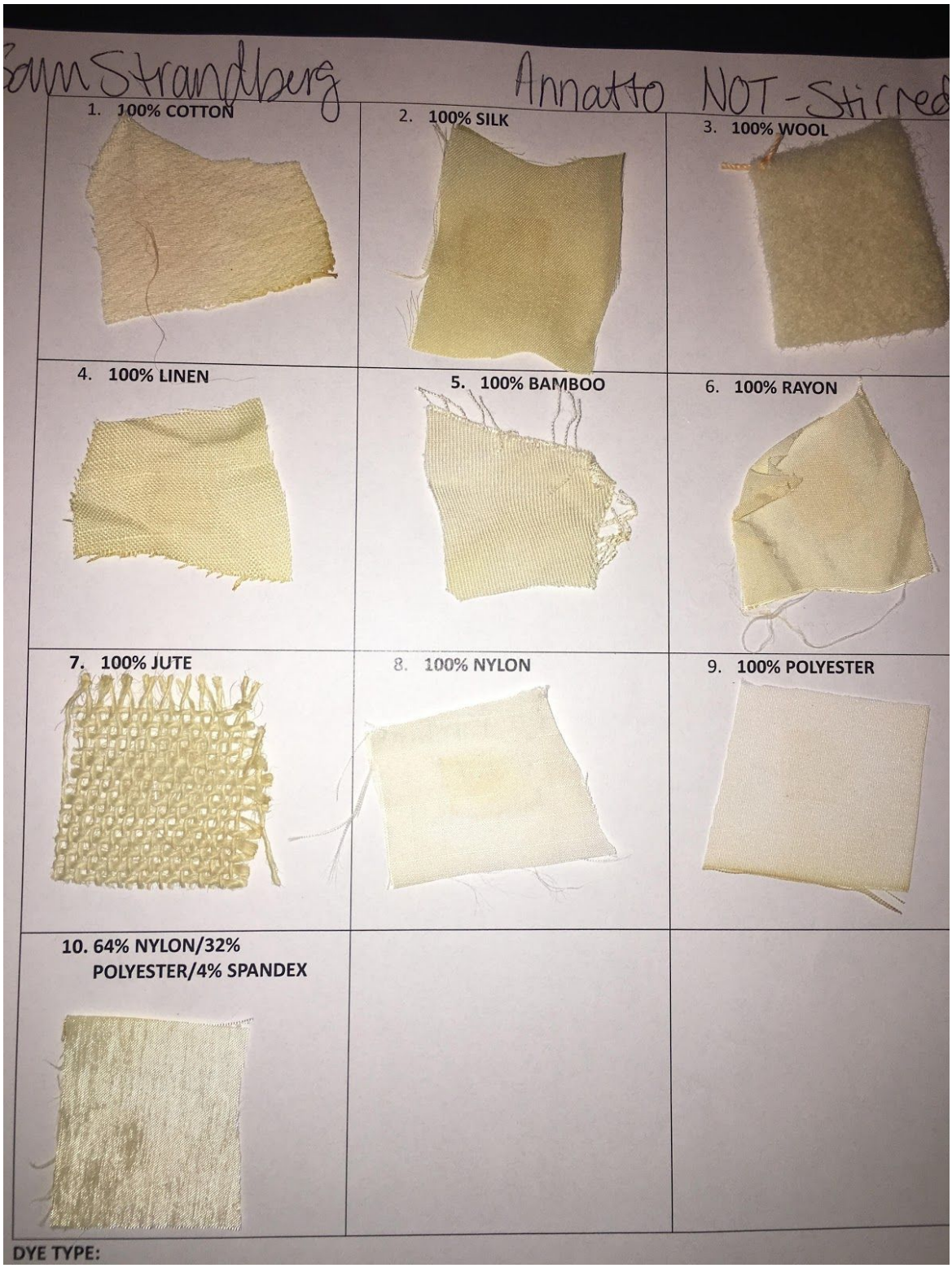
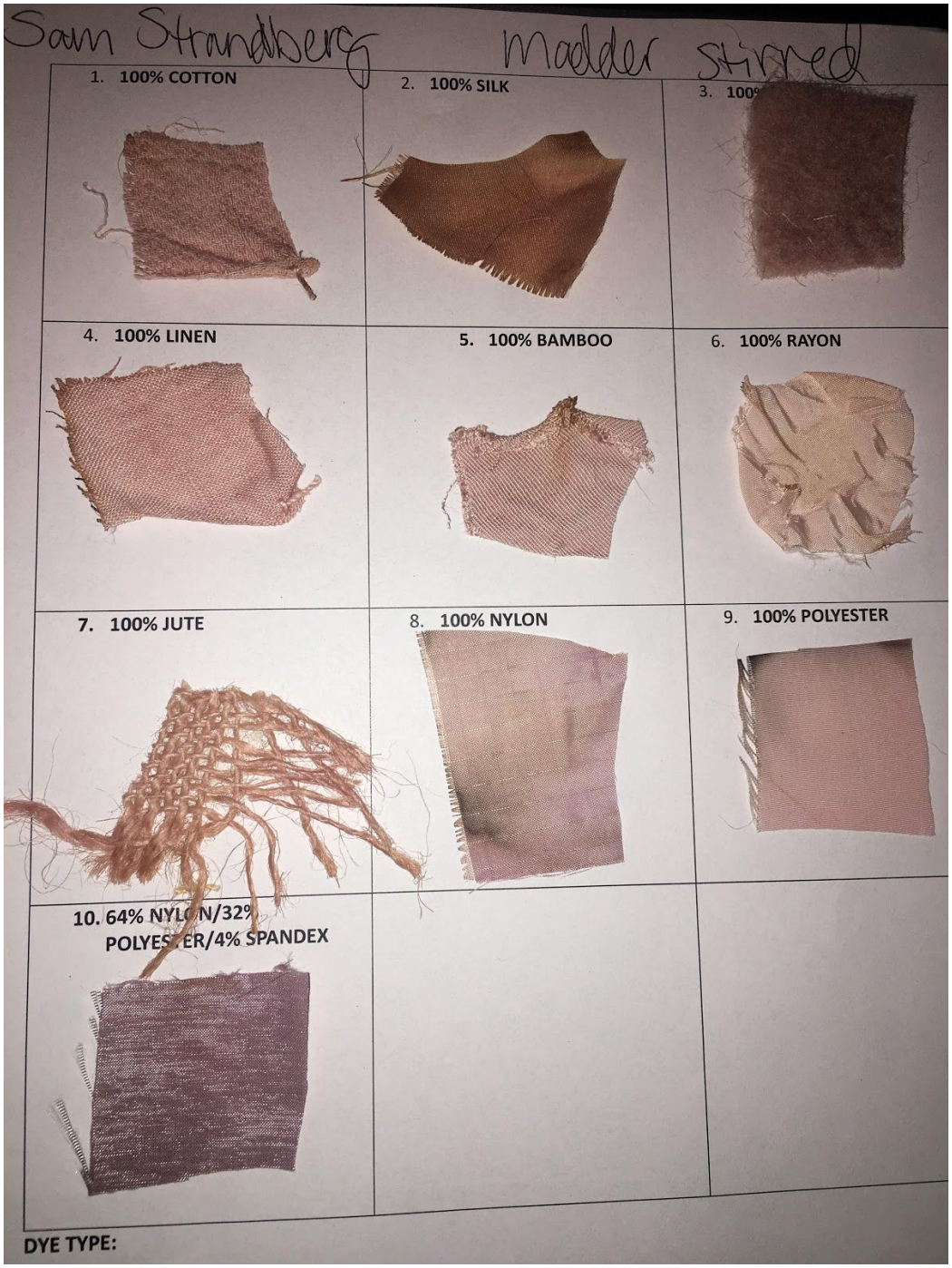
Color Swatches for Annatto Stirred:

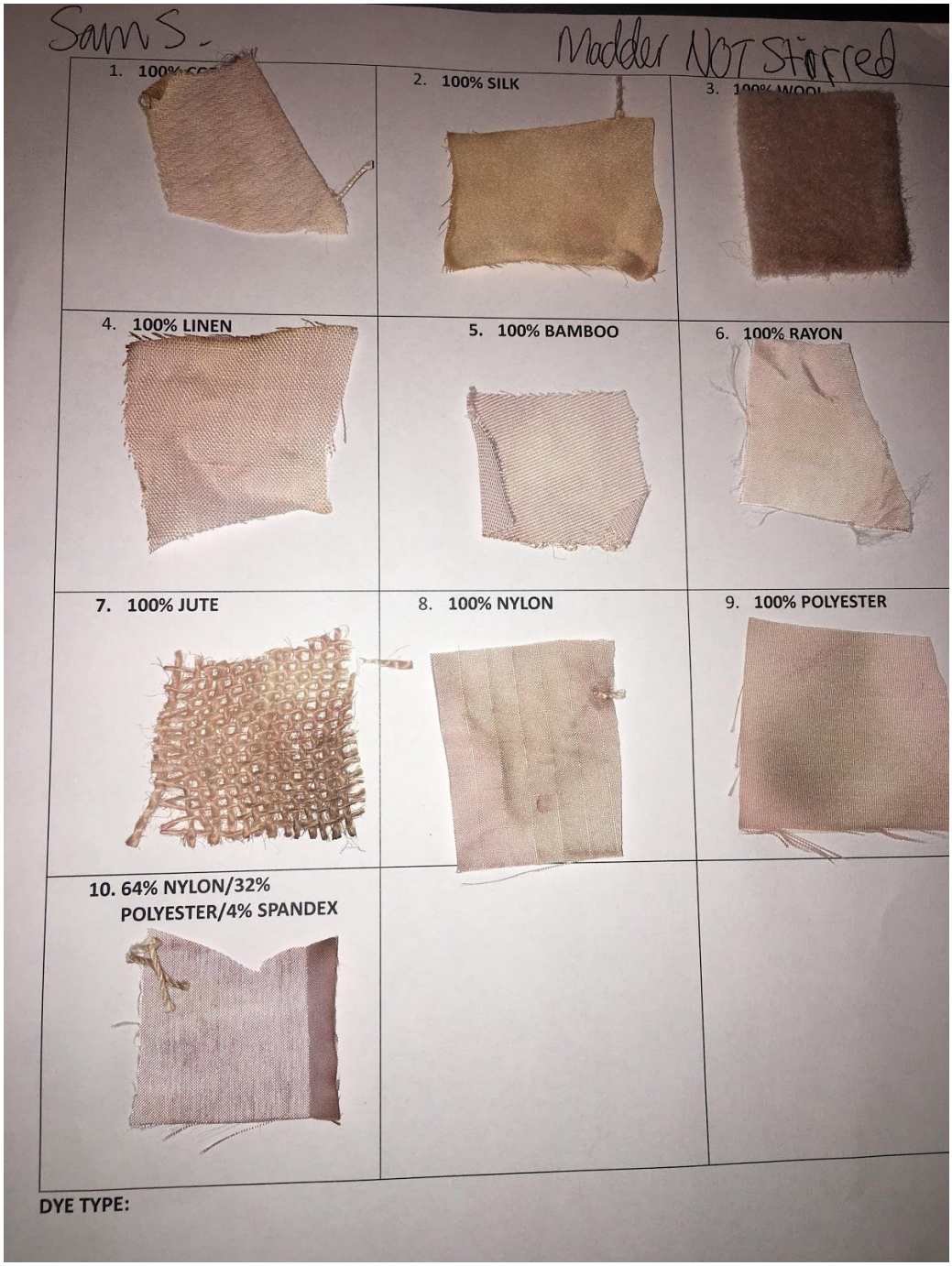
Color Swatches for Annatto Not Stirred:



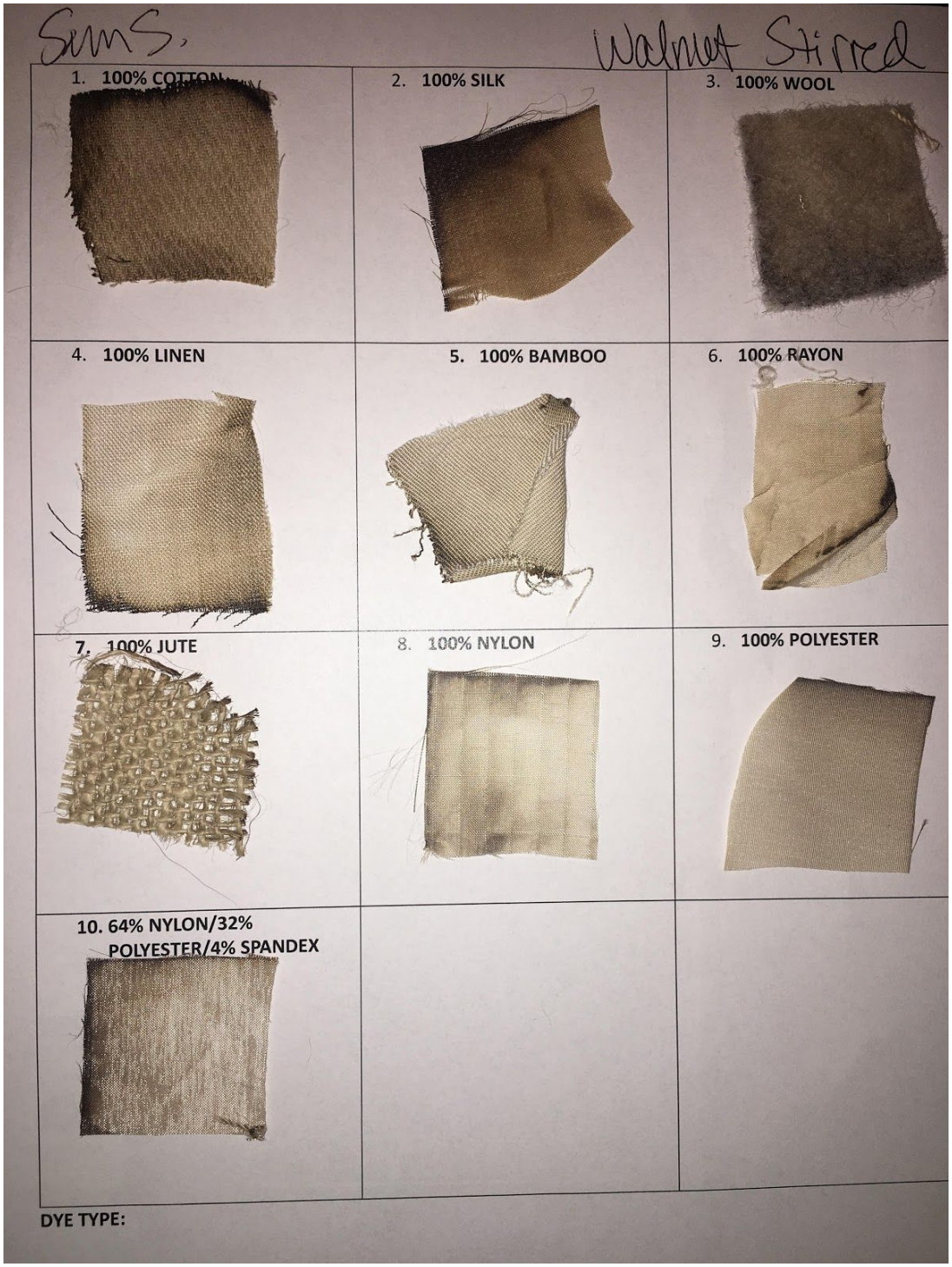
Color Swatches for Madder Stirred:



Color Swatches for Madder Not Stirred:

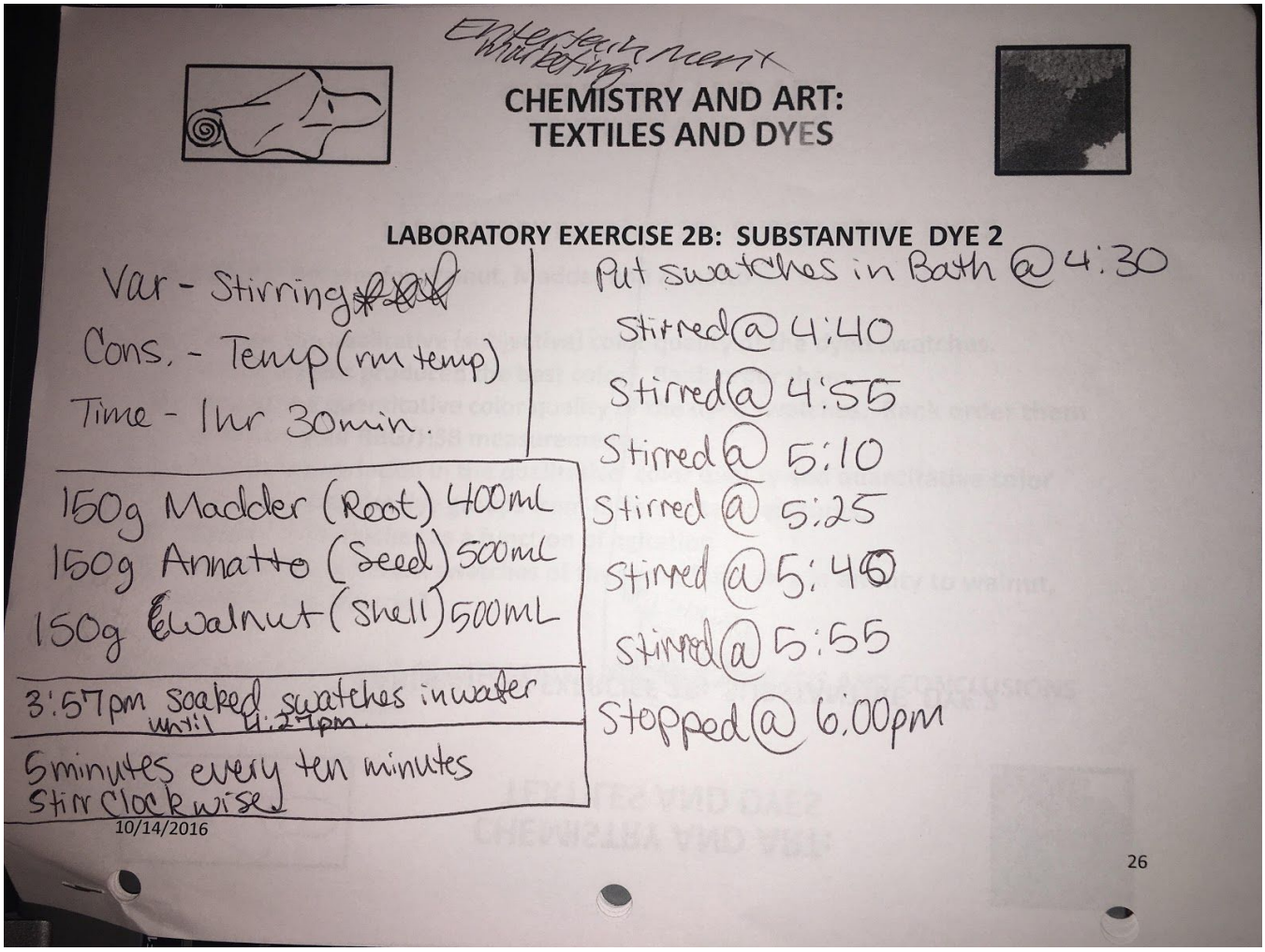


Color Swatches for Black Walnut Stirred:



Color Swatches for Black Walnut Not Stirred:

Substantive Dye Lab 2 Notes:



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CHEMISTRY AND ART:
TEXTILES AND DYES

LABORATORY EXERCISE 2B: SUBSTANTIVE DYE 2

Var - Stirring ~~*~~

Cons. - Temp (rm temp)

Time - 1hr 30min.

150g Madder (Root) 400mL
150g Annatto (Seed) 500mL
150g Walnut (Shell) 500mL

3:57pm soaked swatches in water until 4:27pm.

5 minutes every ten minutes
Stir clockwise

Put swatches in Bath @ 4:30
Stirred @ 4:40
Stirred @ 4:55
Stirred @ 5:10
Stirred @ 5:25
Stirred @ 5:40
Stirred @ 5:55
Stopped @ 6:00pm

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Visual Assessment: Best Annatto Stirred

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

Visual Assessment: Best Annatto Not Stirred

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

Visual Assessment: Best Madder Stirred

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

Visual Assessment: Best Madder Not Stirred

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

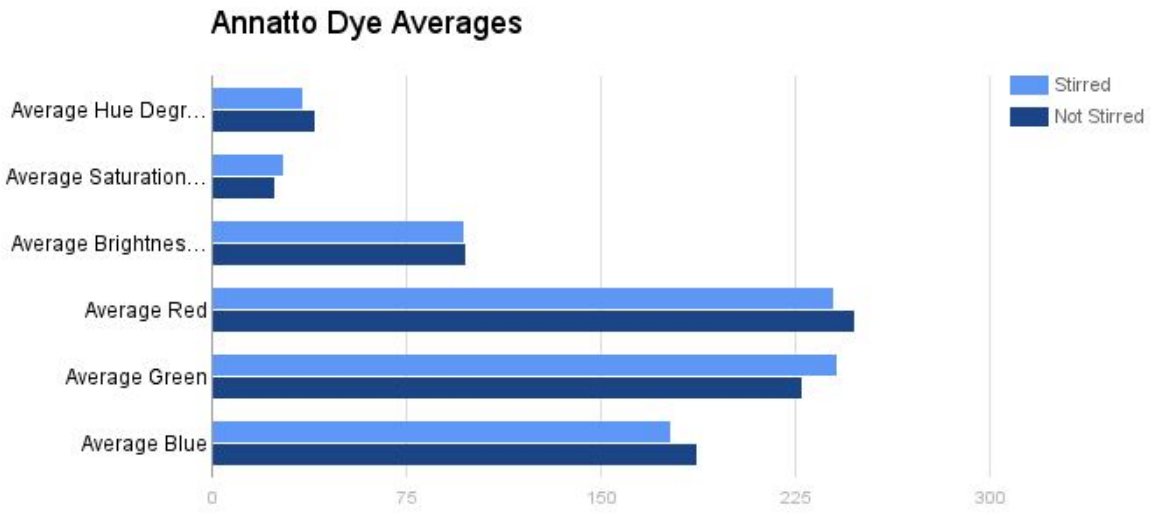
Visual Assessment: Best Black Walnut Stirred

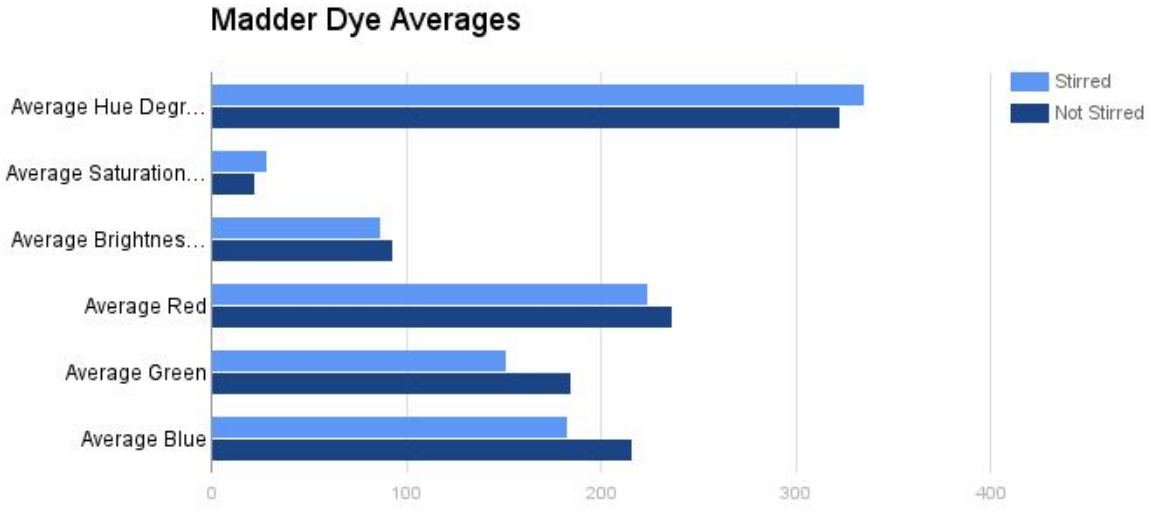
1. Silk
2. Polyester

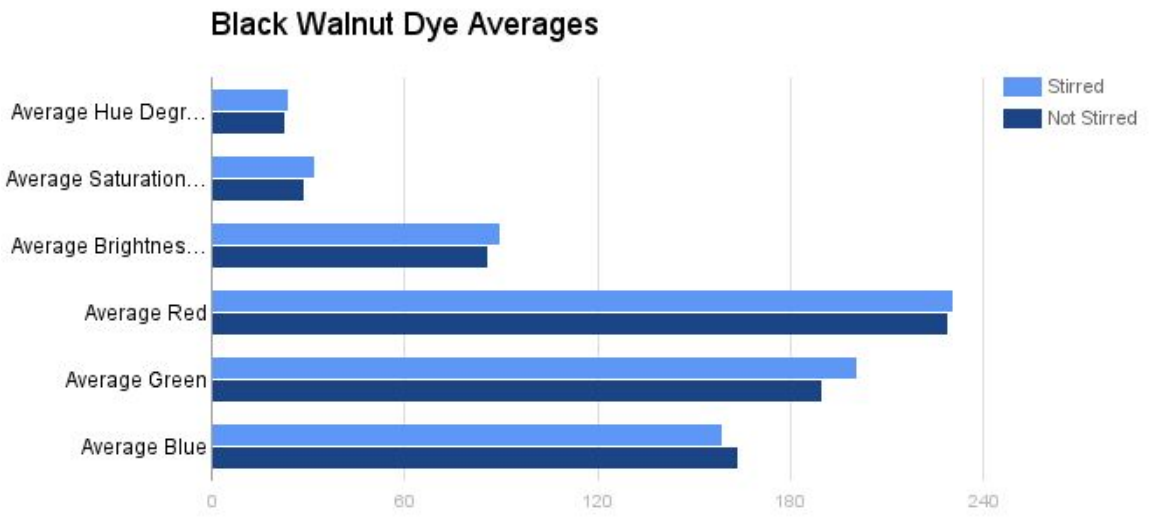
3. 64% Nylon, 32% Polyester, 4% Spandex
4. Rayon
5. Jute
6. Wool
7. Bamboo
8. Linen
9. Cotton
10. Nylon

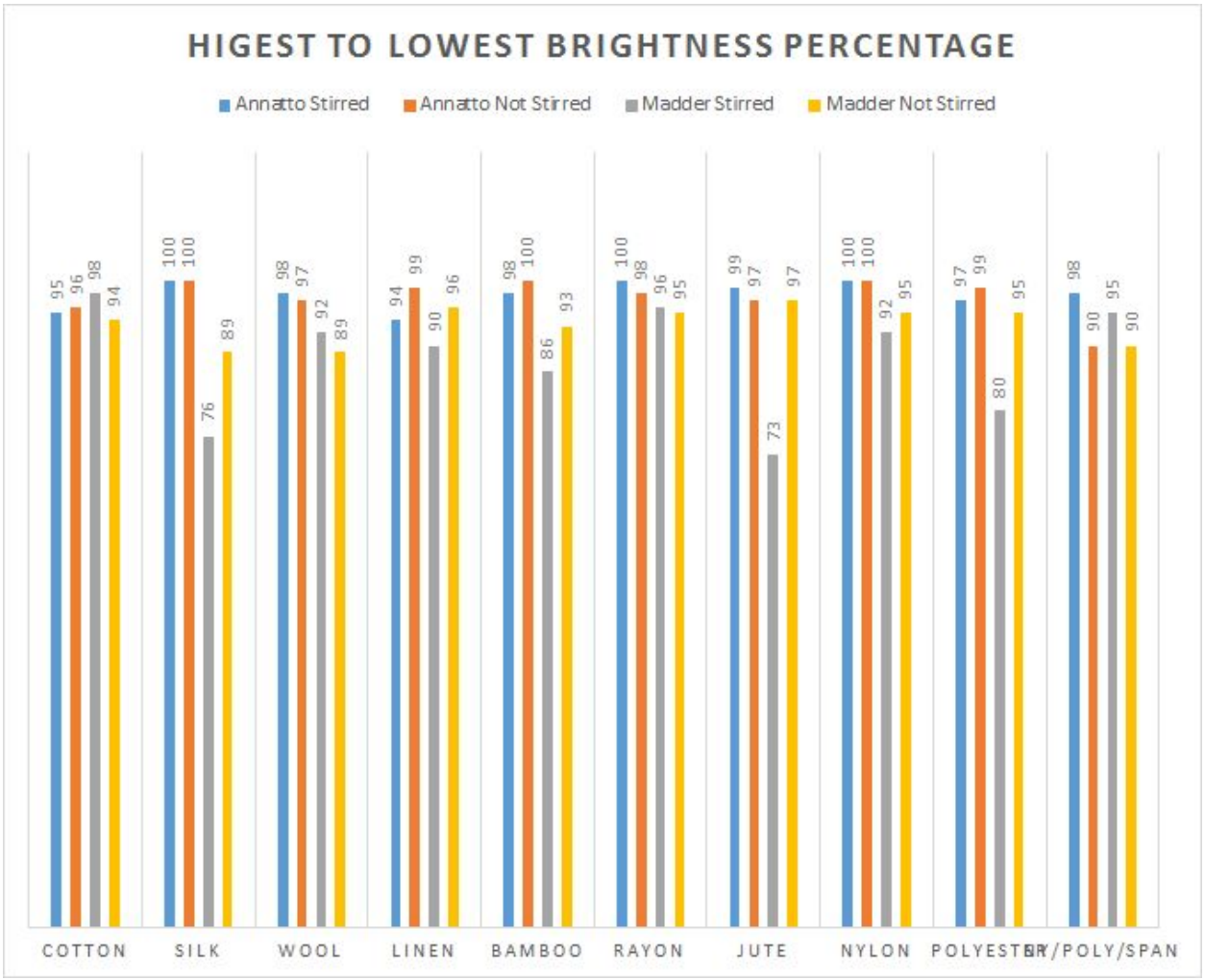
Visual Assessment: Best Black Walnut Not Stirred

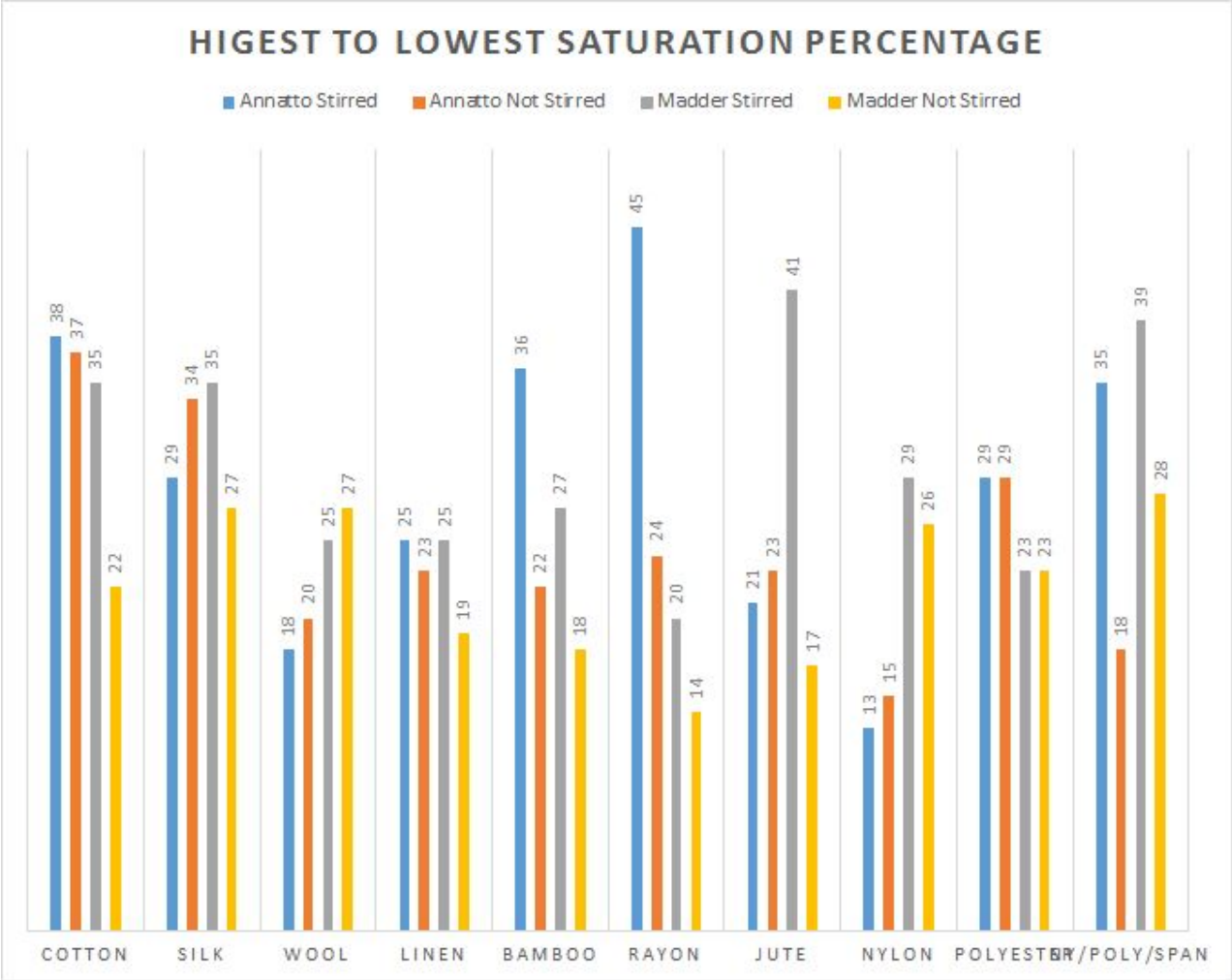
1. Jute
2. Silk
3. Rayon
4. Cotton
5. Polyester
6. 64% Nylon, 32% Polyester, 4% Spandex
7. Bamboo
8. Linen
9. Wool
10. Nylon


Annatto Dye Averages
Average Hue Degr...
Average Saturation...
Average Brightnes...
Average Red
Average Green
Average Blue
0
75
150
225
300
Stirred
Not Stirred


Madder Dye Averages
Average Hue Degr...
Average Saturation...
Average Brightnes...
Average Red
Average Green
Average Blue
0
100
200
300
400
Stirred
Not Stirred


Black Walnut Dye Averages
Average Hue Degr...
Average Saturation...
Average Brightnes...
Average Red
Average Green
Average Blue
0
60
120
180
240
Stirred
Not Stirred


HIGEST TO LOWEST BRIGHTNESS PERCENTAGE
Annatto Stirred
Annatto Not Stirred
Madder Stirred
Madder Not Stirred
95 96 98 94
100 100 76 89
98 97 92 89
94 99 90 96
98 100 86 93
100 98 96 95
99 97 73 97
100 100 92 95
97 99 80 95
98 90 95 90
COTTON
SILK
WOOL
LINEN
BAMBOO
RAYON
JUTE
NYLON
POLYESTER
RY/POLY/SPAN



Discussion/ Analysis:

Interpret Your Data:

From referencing the *Annatto Dye Averages* bar graph, annatto not stirred had 4/6 of higher averages compared to being stirred. Although, average saturation percentage and green had the higher average in annatto stirred.

From referencing the *Madder Dye Averages* bar graph, madder not stirred had 4/6 of higher averages compared to being stirred. But, average hue degrees and average saturation percentage were higher in madder stirred.

From referencing the *Black Walnut Dye Averages* bar graph, madder stirred had ⅝ of higher averages compared to being stirred. The only average that was higher not stirred was the average blue hue.

From referencing the *Highest to Lowest Saturation Percentage* column graph, cotton, silk, and the blended textiles had the highest saturation. The lowest saturation was nylon, wool, and linen.

From referencing the *Highest to Lowest Brightness Percentage* column graph, most textiles all had around the same brightness percentage. But madder stirred had a significantly lower averages.

Draw a Conclusion:

The substantive dye lab experiment with the variable of stirring did not validate my hypothesis that if one would stir textiles in substantive dyes then it will affect the affinity if

the time and temperature is fixed. The experiment is not validated because from the data taken, onc can conclude that, textiles not stirred had the best averages, saturation, and most appealing color of textiles.

Discuss Assumptions:
An assumption I made was that the substantive dye baths that was stirred would create a higher affinity. But the results showed otherwise.

Sources of Error:

An error was comparing our tangible textiles to a computer monitor in a poorly lit room to determine HSB and RGB. Another error was three different people were stirring the substantive dye baths. By doing so there could be a difference in speed and type of stirring being done that would affect the data results. As well we did not use fresh black walnut husk. This could affect our experiment. My excel sheet would not expand for me to include black walnut for the column graphs.This may have left out an underlying perspective of the data.

Possible Improvements:

If we could do this experiment again, I would conduct it not on computer but perhaps with color swatches to determine the shades of annatto, madder, and black walnut. Another improvement would be come up with a more detailed plan on how to stir the dye baths. As well, next time I would try to use all fresh ingredients to assure the purest pigments. I would be sure to use a different program when creating my graph that included more than four variables.

Conclusion: ***A Final Comment***

I concluded that there is not a stronger affinity to textiles that are agitated in a dye bath. Contrary to physical entrapment of dye molecules to the fiber molecules done by stirring agitation, our results showed textiles did better not stirred. Although there was some errors, we can make a generalization that the affinity of substantive dyes is weaker when stirred.