Mordant Dye Experiment

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Abstract:

If one would add mordant to a dye bath then it will impact the color of the dye and the quality of the dye process. The composition of the mordant does not vary based on when in the dye process the mordant is used. The type of mordant used is what changes the color shade obtained after dyeing and also affects the fastness property of the dye. This is due to the covalent bonding between dye molecules and fiber molecules with the help of the mordant and the assistant. One can conclude there is an impact of the dye color and the quality of the dye process when a type of mordant is being used.

Introduction:

The purpose of the experiment is to discover if one would add mordant to a dye bath then it would it impact the color of the dye and the quality of the dye process?

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

Dye molecules may be mechanically trapped in the fiber through hydrogen bonds or may be chemically attracted to the fiber through covalent bonding.

Mordants are substances that are used to fix a dye forever to the fibers through covalent bonding. Mordants are used with salts (metal ions) which then stick to the fabric and render as points of attachment for dye molecules. Mordants are often attaches to component called an assistant. The assistant enhances the fixing of the mordant to the fibers.

Apparatus:

- Safety Glasses
- Rubber Gloves
- Plastic Apron
- Glass Stirring Rods
- Glass Beakers
- Permanent Black Ink Pen
- Needles and Threads
- Fabric Samples (Five swatch sets of each type)
    1. Wool
    2. Silk
    3. Cotton

- One dye for two baths per group (Madder)
- Two mordants per group (Alum + Cream of Tartar) (Calcium Carbonate)
- 2 post-dye additives per group (Oxalic Acid) (Citric Acid)
- pH Meter
- Hot Plate
- Wooden Clothespins
- Drying Rack
- Newspapers

Procedures:

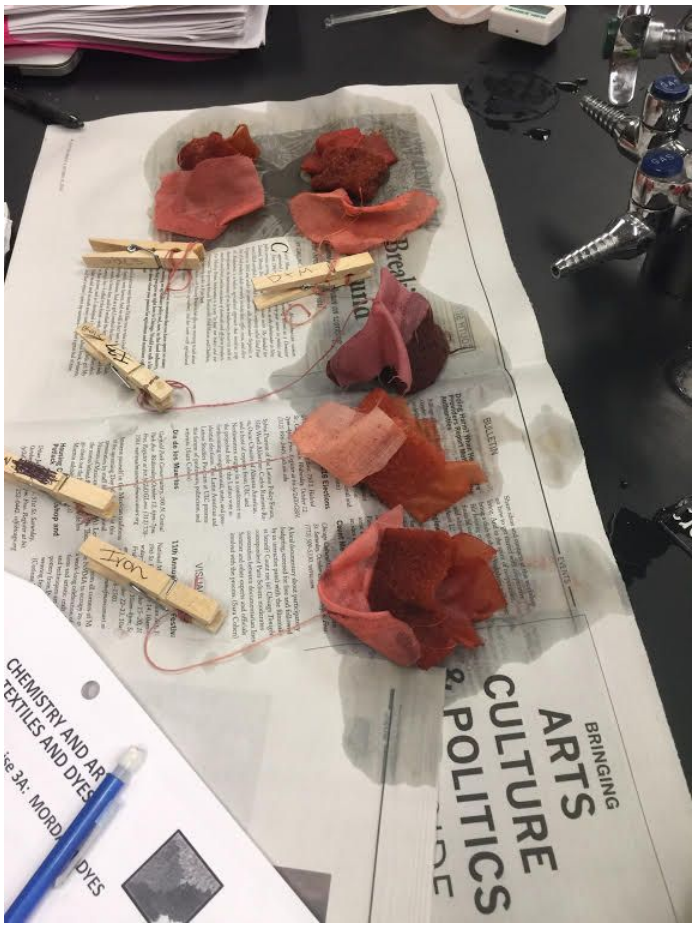
Pre-Mordant Baths: (Calcium Carbonate)
Poured 10 mL of hot water into beaker. Added 1g of mordant to beaker. Added 500 mL of cool water to beaker. Mixed well with glass stirring rod. Placed 1 set of swatches in beaker. Placed beaker onto hot plate. Raised temperature to 80 degrees celsius. Had swatch set simmer for 45 minutes. Rinsed out swatch set. Added swatch set to dye bath. Raised dye bath temperature to 80 degrees celsius. Had swatch set simmer for 30 minutes. Rinsed efficiently. Laid on newspaper.

Mordant Dye Baths: (Calcium Carbonate)
Poured 10 mL of hot water into beaker. Added 1g of mordant to beaker. Added 500 mL of cool water to beaker. Mixed well with glass stirring rod. Placed 3 set of swatches in beaker. Placed beaker onto hot plate. Had swatch set

simmer for 30 minutes. Rinsed out swatch set. Took 2 swatch sets to use for 2 different post mordanting processes.

Pre-Mordant Baths: (Alum and Cream of Tartar)
Poured 10 mL of hot water into beaker. Added 1g of mordant to beaker. Added 500 mL of cool water to beaker. Mixed well with glass stirring rod. Placed 1 set of swatches in beaker. Placed beaker onto hot plate. Raised temperature to 80 degrees celsius. Had swatch set simmer for 45 minutes. Rinsed out swatch set. Added swatch set to dye bath. Raised dye bath temperature to 80 degrees celsius. Had swatch set simmer for 30 minutes. Rinsed efficiently. Laid on newspaper.

Mordant Dye Baths: (Alum and Cream of Tartar)
Poured 10 mL of hot water into beaker. Added 1g of mordant to beaker. Added 500 mL of cool water to beaker. Mixed well with glass stirring rod. Placed 3 set of swatches in beaker. Placed beaker onto hot plate. Had swatch set simmer for 30 minutes. Rinsed out swatch set. Took 2 swatch sets to use for 2 different post mordanting processes.



Post-Mordant Baths:

Added 10 mL of oxalic acid to beaker filled with warm water. Put 1 dyed swatch set into beaker. Brought to simmer dye bath for 10 minutes. Laid on newsprint to oxidize. Rinsed thoroughly.

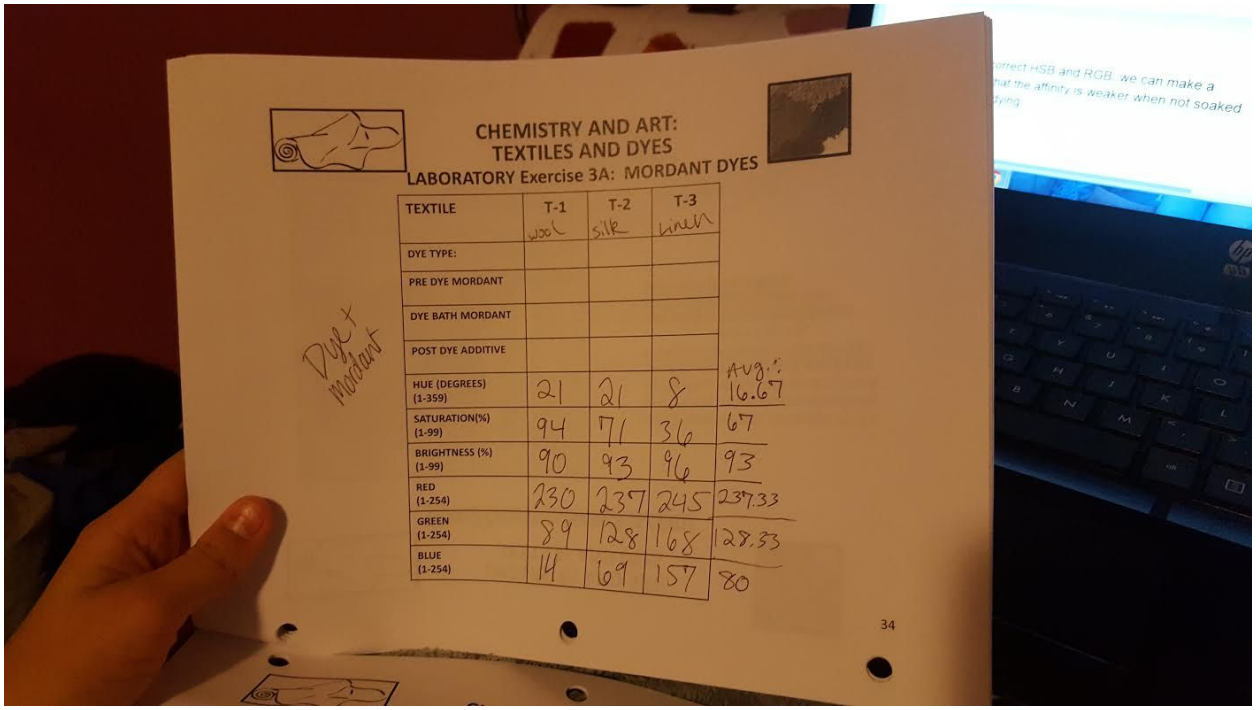
Determining HSB and RGB:

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.

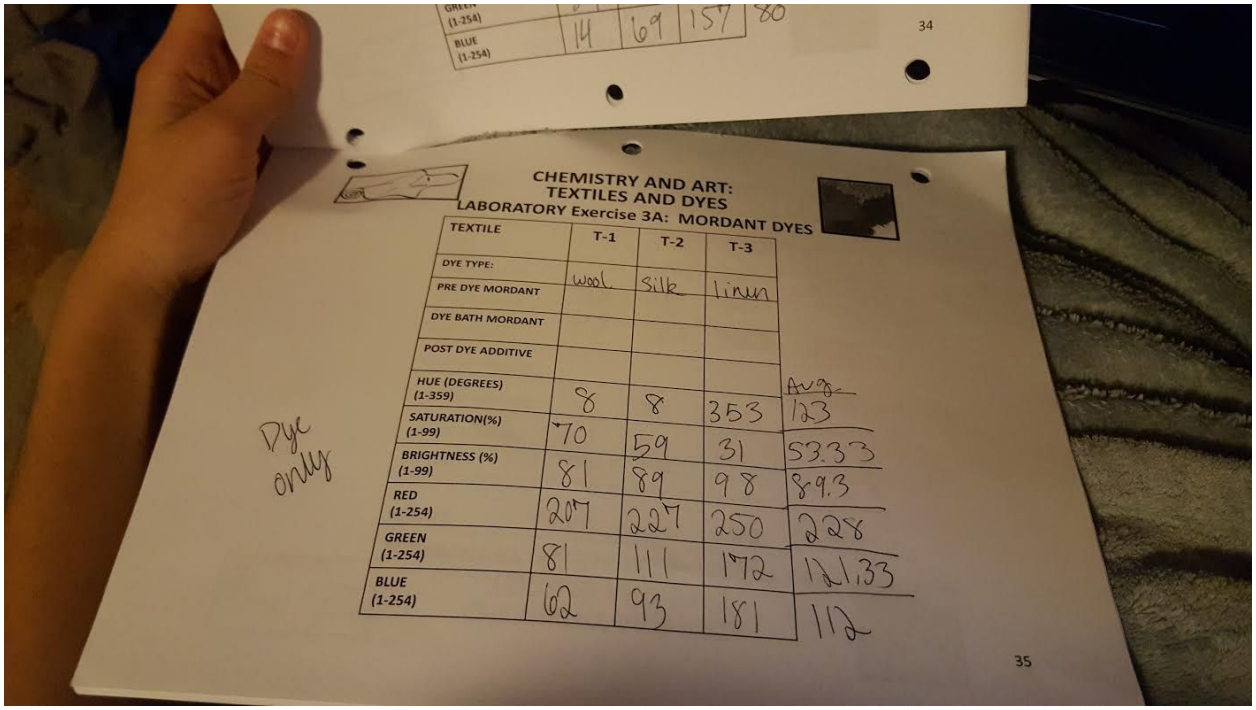
Results/Data:

Visual Assessment:

Personally I thought that all the textiles dyed well in all the conditions tested. I visually enjoy them all equally at all the different hues. So there was no need to rank them.



TEXTILE	T-1 wool	T-2 silk	T-3 linen	
DYE TYPE:				
PRE DYE MORDANT				
DYE BATH MORDANT				
POST DYE ADDITIVE				
HUE (DEGREES) (1-359)	21	21	8	Avg.: 16.67
SATURATION(%) (1-99)	94	71	36	67
BRIGHTNESS (%) (1-99)	90	93	96	93
RED (1-254)	230	237	245	237.33
GREEN (1-254)	89	128	168	128.33
BLUE (1-254)	14	69	157	80



GREEN (1-254)				80
BLUE (1-254)	14	69	157	

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CHEMISTRY AND ART:
TEXTILES AND DYES
LABORATORY Exercise 3A: MORDANT DYES

TEXTILE	T-1	T-2	T-3	
DYE TYPE:	wool	silk	linen	
PRE DYE MORDANT				
DYE BATH MORDANT				
POST DYE ADDITIVE				
HUE (DEGREES) (1-359)	8	8	353	Avg. 123
SATURATION(%) (1-99)	70	59	31	53.33
BRIGHTNESS (%) (1-99)	81	89	98	89.3
RED (1-254)	207	227	250	228
GREEN (1-254)	81	111	172	121.33
BLUE (1-254)	62	93	181	112

Dye only

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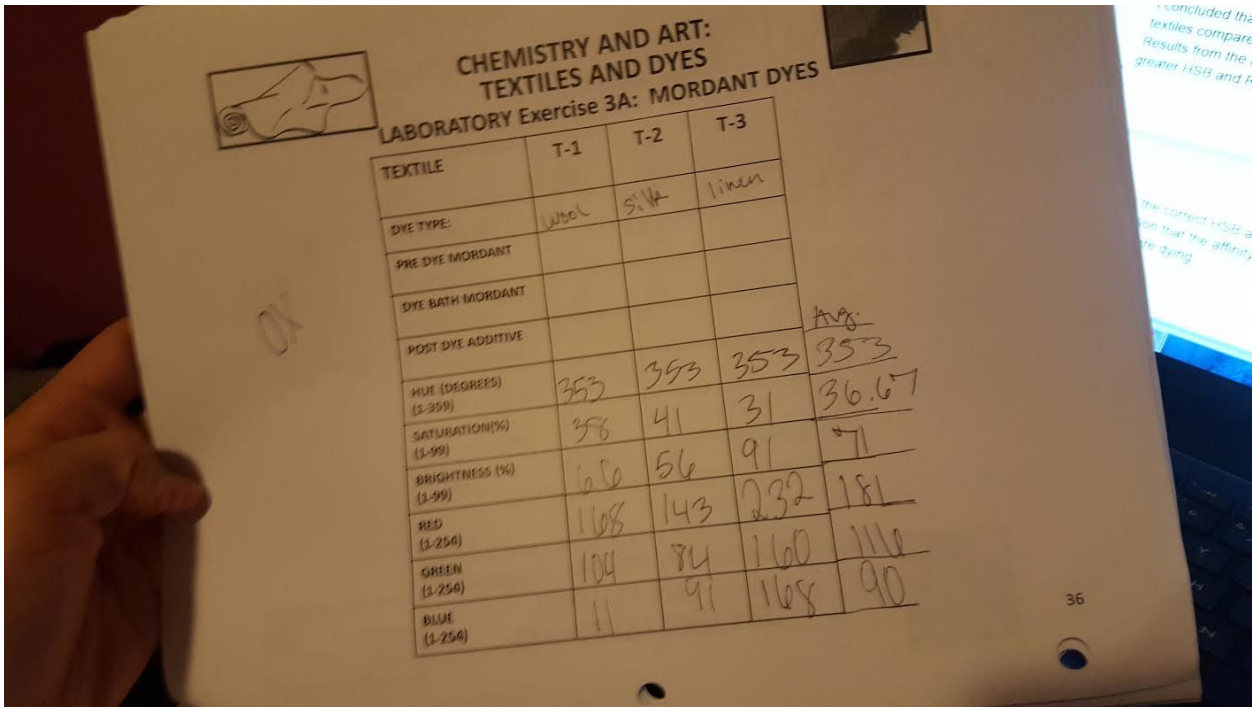

CHEMISTRY AND ART:
TEXTILES AND DYES
LABORATORY Exercise 3A: MORDANT DYES

TEXTILE	T-1	T-2	T-3	
DYE TYPE:	wool	silk	linen	
PRE DYE MORDANT				
DYE BATH MORDANT				
POST DYE ADDITIVE				
HUE (DEGREES) (1-359)	353	353	353	Avg. 353
SATURATION(%) (1-99)	38	41	31	36.67
BRIGHTNESS (%) (1-99)	66	56	91	71
RED (1-254)	168	143	232	181
GREEN (1-254)	104	84	160	116
BLUE (1-254)	11	91	168	90

OK

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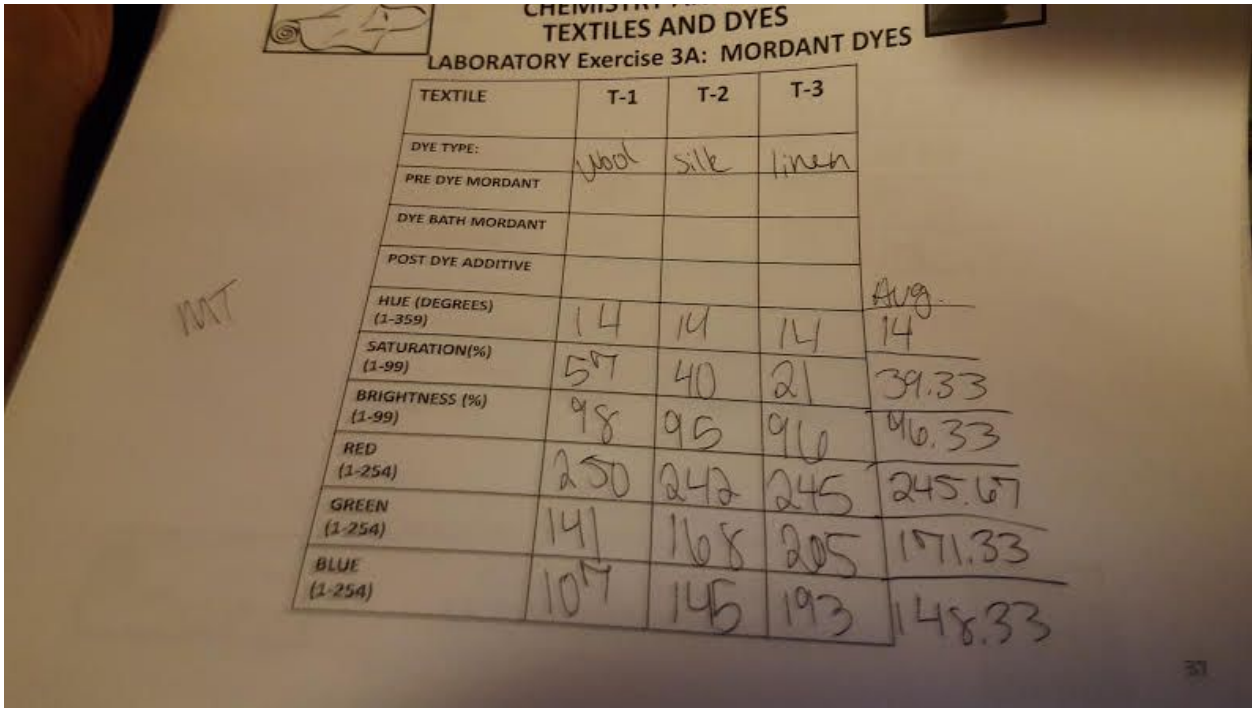

CHEMISTRY AND ART:
TEXTILES AND DYES
LABORATORY Exercise 3A: MORDANT DYES

TEXTILE	T-1	T-2	T-3	
DYE TYPE:	Wool	Silk	Linen	
PRE DYE MORDANT				
DYE BATH MORDANT				
POST DYE ADDITIVE				
HUE (DEGREES) (1-359)	14	14	14	14
SATURATION(%) (1-99)	57	40	21	39.33
BRIGHTNESS (%) (1-99)	98	95	96	96.33
RED (1-254)	250	242	245	245.67
GREEN (1-254)	141	168	205	171.33
BLUE (1-254)	107	145	193	148.33

Avg.

NOT

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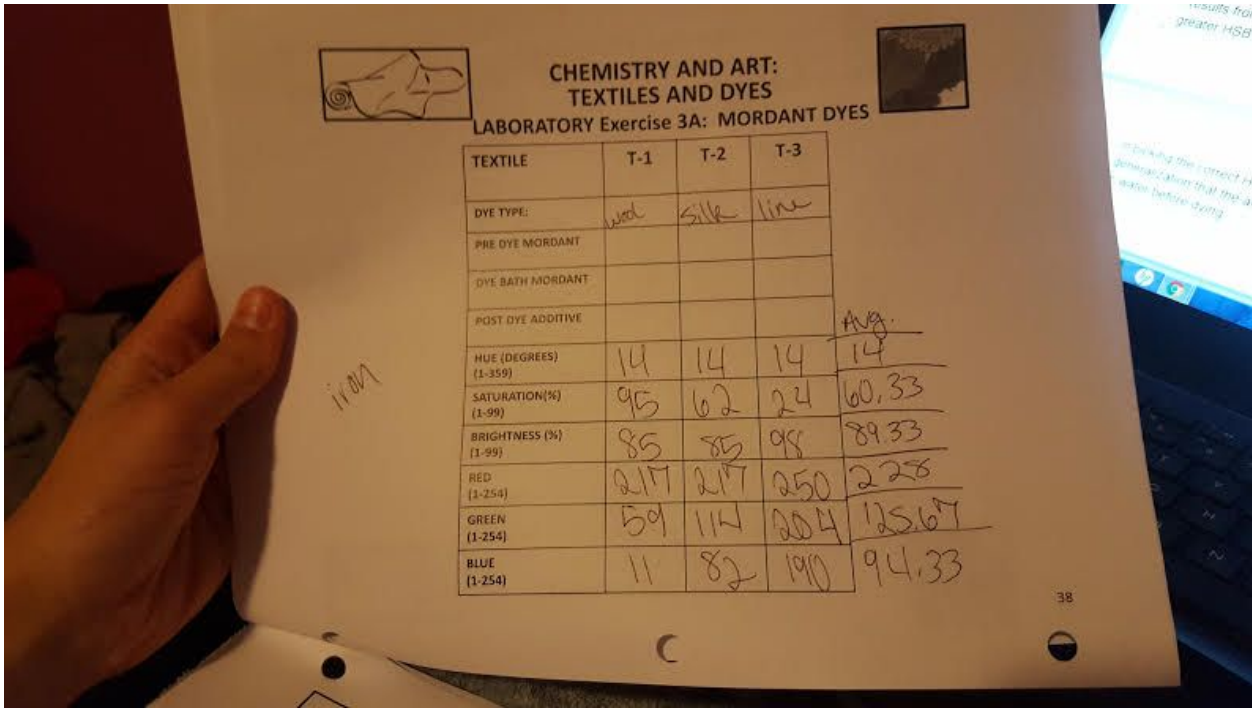

CHEMISTRY AND ART:
TEXTILES AND DYES
LABORATORY Exercise 3A: MORDANT DYES

TEXTILE	T-1	T-2	T-3	
DYE TYPE:	wool	Silk	linen	
PRE DYE MORDANT				
DYE BATH MORDANT				
POST DYE ADDITIVE				
HUE (DEGREES) (1-359)	14	14	14	14
SATURATION(%) (1-99)	95	62	24	60.33
BRIGHTNESS (%) (1-99)	85	85	98	89.33
RED (1-254)	217	217	250	228
GREEN (1-254)	59	114	204	125.67
BLUE (1-254)	11	82	190	94.33

Avg.

NOT

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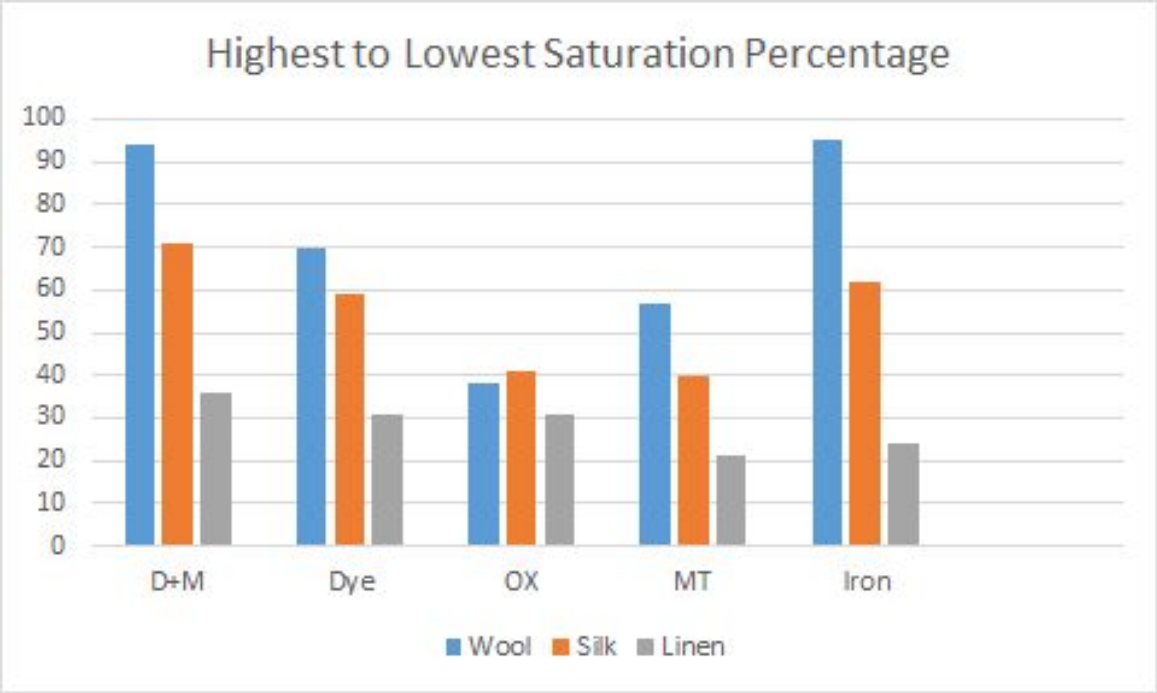
SAM (#3)
1. 100% WOOL
2. 100% SILK
3. 100% LINEN
5. 100% SILK
WV
MT
OX
DYE



Discussion/ Analysis:

Interpret your data:

From referencing the *Highest to Lowest Saturation Percentage* column graph, The type of mordant used changes the saturation percentage of the pigment

obtained after dyeing. For example using dye and mordant or dye mordant and iron (assistant) had higher saturation.

As well the type of mordant used affected the fastness property of the dye to the pigment held in the fabric. As seen in the *Highest to Lowest Saturation Percentage* column graph, linen had the overall lowest saturation averages. This can also be seen in the *Swatch Set Results*. This could be because linen is a plant based fiber.

Sources of Error:

During the lab experiment I and my group often found ourselves confused on which swatch sets go into what beaker. Also it was a struggle comparing the color of the swatches over the computer monitor. As well, after our swatches had dried, I could still left over dye residue on some swatches from improper rinsing.

Possible Improvements:

If we did this lab another time, I would read through the directions in its entirety instead of skimming through it. Also, if we could do this experiment again, I would conduct it not on computer but perhaps with color swatches to

determine all the variety of shades. Another adjustment to make would be to thoroughly rinse the textiles to not get an over saturated color.

Conclusion: ***A Final Comment***

I concluded that there is a impact on the dye color and the quality of the dye process if mordants was used. Results showed the composition of the mordant does not vary based on when in the dye process the mordant is used. The type of mordant used changes the color shade obtained after dyeing and also affects the fastness property of the dye. This is due to the covalent bonding between dye molecules and fiber molecules with the help of the mordant and the assistant. Although there was some limitations, we can make a generalization that there was indeed an impact on color when mordants were used.