Study on Lab to Bulk Shade Variation

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Abstract

The accurate correlation of a laboratory dyeing to a production dyeing lot is a universal concern of dyeing operations. Laboratory dyeing techniques, which are both accurate and repeatable to bulk, dyeing processes, are absolutely essential for the optimization of the production output and the cost effectiveness of the modern competitive dyeing operation. For example, it has been reported that the cost of each colour correction or production add can increase dyeing costs as much as 30%. Dye lots that must be stripped and re dyed can cost an addition al1 70% compared to normal dyeing. In textile industry cotton have dominant market share having share of 58.45% in worldwide - market. These fabrics are famous due to their aesthetic value and user friendly performance. Not only do poor quality dyeing result in higher production costs, but they also lead to difficulties in production planning, increased pollution loads on waste treatment facilities, and prolonged delivery times. Maximization of "right-first-time" dyeing and minimization of re dyeing, colour additions, and off- quality problems, such as shading within the dye lot, are direct results of optimum lab-to-plant dyeing correlation.

Points

1. The ultimate aim in dyeing is to match the bulk with lab dip.
2. The bulk should come according to the lab dip in the first attempt.
3. If it is not so then we should immediately take decision of additions to avoid huge loss.
4. Sometimes delay of chemicals causes loss of time, loss in production and can also had an adverse effect on dyeing if delay is too long.

The main advantages of perfect dyeing are:-

1. Extra colour and chemicals are not wasted.
2. On time delivery.
3. No wastage of water.
4. No wastage of time.

EXPERIMENTAL WORK

Material:

Cotton = 100%
Polyester/cotton =40/60

Methods:

A. Lab Dyeing Procedure:

1. Firstly the recipe is predicted by using the spectrophotometer.
2. The spectrophotometer gives three possible recipes.
3. Then the ready for dyeing sample is dyed in the lab by using the three recipes.
4. Then the closest match to the standard is sending to the buyer for its approval.
5. After approval the sample is again dyed in the lab for the reconfirmation of the recipe.
6. Then the confirmed recipe is used for the bulk dyeing.
   After dyeing, small sample is taken from the bulk & assessed in the spectrophotometer. If the value of delta E comes less than 1.0 then the sample is passed. If the value comes more than 1.0 then additions in the bulk recipe are made and fabric is reprocessed until its value comes below 1.0.

The dyepot was filled with the pre-dissolved dye, pre-dissolved salt, water and fabric. It is clear from, dyeing was started at RT and temperature was allowed to rise to 60^0C. After holding the temperature at 60^0Cfor 15 min, required amount of glauber salt and soda ash was added and dyeing was continued for 30 min. After the completion of dyeing, dye bath was drained. Soaping was carried out at M: L 1:5 of the dyed fabric at 95 °C for 10 min with 2 gpl of soap. The fabric was rinsed and then dried.

Evaluation Dyed Fabric for colour difference and strength

The lab and production dyed sample is evaluated under identical conditions. First sample is dyed in the lab and then the same recipe is taken for production. Many dyes are very sensitive to the heat and/or the moisture content of the fabric. It is very important that the shade sampling technique and dyed sample presentation should be systematic, so that the colour evaluated is representative of the true shade of the lab dyeing or production lot.

After sampling, the key choice becomes whether the sample is to be visually evaluated, instrumentally evaluated, or both. There are pros and cons depending on the product mix and the demands of the customers. Various key factors to consider include:

1. Fabric surface and geometric properties.
2. Solid shades vs. cross dyes.
3. Shade tolerances allowed.

Visual shade matching:

- Use standardized and acceptable illumination.
- Use standard, uniform backgrounds.
- All personnel involved with shade evaluation should be tested for colour blindness.
- All personnel should be trained using standard repeatable techniques.

B. Bulk Dyeing Procedure:

1) Take auxiliary in addition tank 1.
2) According to recipe at 60^0c. Temp.
3) Loading of fabric in the m/c, run for 10 min.
4) Then prepare caustic soda solution in addition tank 2 for scouring, dosing at 60^0c. Temp.
5) Prepare a solution of hydrogen peroxide in addition tank 1for bleaching.
6) Peroxide dosing at 60^0c temperature.
7) Raising the temperature to 110^0c for peroxide holding, run time 20 min.
8) Rinsing & cooling 80^0c. Temperature for zero min & Drain.
9) Prepared a solution of acetic acid &invatex Ac in addition tank 2 to maintain the ph.
10) Dosing, run time 4 min. at temp 60^0c.
11) H_2O_2 killer for removing H_2O_2 dosing, run time 10 min. At 60^0c temp.
12) Check the PH of RFD fabric. (5.5-6.5).
13) Run time 6 min. at 95^0c temperature & drain.
14) Hot wash 80^0c for 10 min.
15) Cold wash & drain.
16) Add Colour for 10 min. at 60^0c temperature.
17) Colour dosing to the m/c at 60^0c for 20 min.
18) Colour holding in the m/c at 60^0c temperature for 20 min.
19) Add G. salt in addition tank dosing at 60^0c for 20min.
20) G.salt holding at 60^0c for 20min.
21) Soda dosing in the machine for 20 min. at 80^0c.
22) Soda holding at temperature 60^0c. For 35 min.
23) Check the soda PH of dye bath (10.5-10.7)
24) Then add caustic soda at 60^0c for 5 min.
25) Rinse for 2 min.
26) Add the chemical in addition tank-1 Invatex AC, Acetic acid at 60^0c for 10 min
27) Check Ph of acid 5.5-6.
28) Stock tank of m/c, water temp 75^0c.
29) Soaping at 95^0c for 10 min.
30) Rinsing & cooling for 70^0c temperature.
31) Cold wash for 5 min. &drain.

RESULTS AND DISCUSSION

RECIPE- A

Nova Navy SG= 3.30 %
Nova Ruby S-3B=0.93%
Nova Yellow S-3R=0.68%
Common Salt=70g/lit
Soda ash =20g/lit

Sample		DE	DL	DC	DH	Strength	Remarks
Standard		_	_	_	_	100	
Lab	D65/10	0.316	0.270	0.002	0.164	89.36	Pass
	F11/10	0.413	0.381	-0.078	0.139	_	_
	A/10	0.495	0.278	0.052	-0.407	_	_
Bulk	D65/10	0.625	0.146	-0.604	-0.070	91.33	Pass
	F11/10	0.834	0.304	-0.773	-0.080	_	_

	A/10	0.827	0.203	-0.594	-0.540	_	_

Table I: Results of lab & bulk dyeing of cotton with Recipe- A

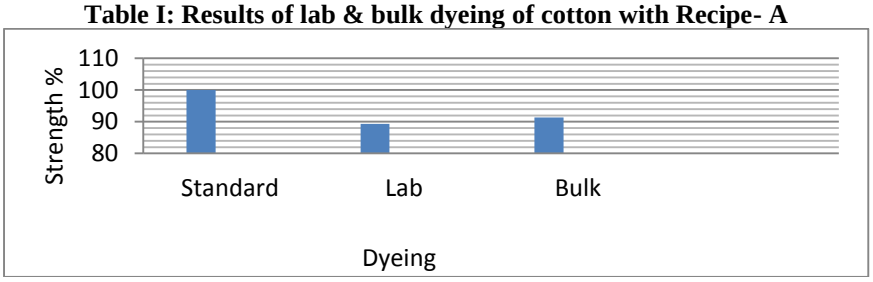

Figure: 1 Strengths of samples dyed in lab & bulk with Recipe- A

Cotton fabric samples were dyed in laboratories as well as in production. The dyed samples were evaluated for colour difference & strength. The samples were evaluated using different light source like D65, F11 & A at 10^0 observed. The results are given in Table-I and represented in figure -1

It was observed that the fabric dyed in bulk was darker than the fabric dyed in laboratory. This may be due to very good contact between fabric & dye liquor in soft flow machine.

Here, DE values of both the samples were close to standard sample.

RECIPE-B

Polyester-

Colourline Red XFBN=1.238%
Colourline Yellow Brown XF=0.43%

Cotton-

Nova Blue FNR=0.005%
Nova Ruby S3B=1.650%
Nova Yellow S3R=0.744%
Common Salt=50 g/lit
Soda ash =18 g/lit

Table II: Results of lab & bulk dyeing of cotton with Recipe- B

Sample		**DE**	**DL**	**DC**	**DH**	**Strength**	**Remarks**
Standard		_	_	_	_	100	_
Lab	D65/10	0.224	-0.219	0.048	0.002	102.20	Pass
	F11/10	0.250	-0.116	0.217	0.047	_	_
	A/10	0.269	-0.196	-0.050	0.117	_	_
Bulk	D65/10	0.560	0.058	-0.266	-0.489	94.72	Pass
	F11/10	0.529	0.091	-0.156	-0.498	_	_
	A/10	0.531	0.009	-0.378	-0.373	_	_

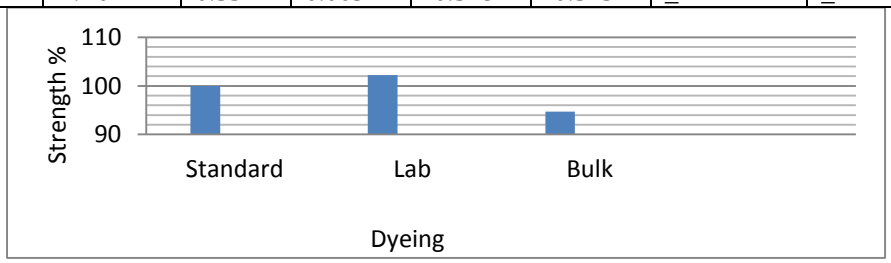

Figure 2: Strengths of samples dyed in lab & bulk with Recipe- B

Cotton fabric samples were dyed in laboratories as well as in production. The dyed samples were evaluated for colour difference & strength. The samples were evaluated using different light source like D65, F11 & A at 10^0 observed. The results are given in Table-II and represented in figure -2. It was observed that the fabric dyed in bulk was lighter than the fabric dyed in laboratory. This may be due to very good contact between fabric & dye liquor in soft flow machine. However, DE values of both the samples were close to standard sample.

RECIPE-C

Nova Blue TS-GE=1.15%
Soda ash =20 g/lit
Nova Red TS3B=0.55%
Nova Yellow S3R=1.374%
Common Salt=60 g/lit

Sample	**DE**	**DL**	**DC**	**DH**	**Strength**	**Remarks**

Standard		_	_	_	_	100	_
Lab	D65/10	0.534	-0.138	0.310	0.227	110.11	Pass
	F11/10	0.512	-0.123	0.313	0.213	_	_
	A/10	0.520	-0.117	0.321	0.218	_	_
Bulk	D65/10	1.332	0.258	1.277	0.278	101.69	Fail
	F11/10	1.459	0.309	1.415	0.180	_	_
	A/10	1.444	0.295	1.201	0.745	_	_

Table III: Results of lab & bulk dyeing of cotton with Recipe- C

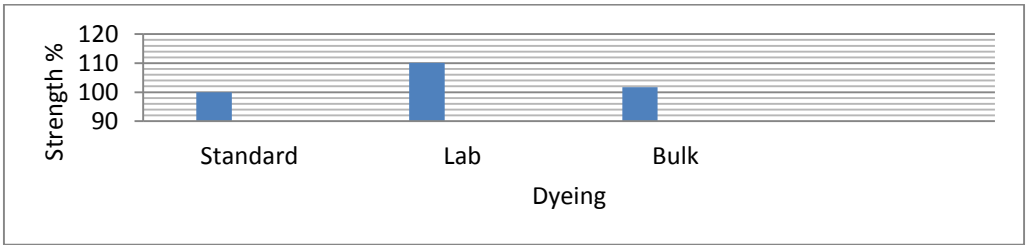

Figure: 3Strengths of samples dyed in lab & bulk with Recipe- C

Cotton fabric samples were dyed in laboratories as well as in production. The dyed samples were evaluated for colour difference & strength. The samples were evaluated using different light source like D65, F11 & A at 10^0 observed. The results are given in Table-III and represented in figure -3. It was observed that the fabric dyed in bulk was lighter than the fabric dyed in laboratory. This may be due to very good contact between fabric & dye liquor in soft flow machine. The bulk sample strength close to the standard but difference in DE value. However, DE values of lab samples were close to standard sample.

RECIPE-D

Nova Scorlet C6G=0.328%
Nova Pink S2B=0.468%
Common Salt=30g/lit
Soda ash =14g/lit

Sample		**DE**	**DL**	**DC**	**DH**	**Strength**	**Remarks**
Standard		_	_	_	_	100	_
Lab	D65/10	0.381	-0.326	-0.019	-0.196	103.63	Pass
	F11/10	0.372	-0.322	-0.121	-0.142	_	_
	A/10	0.414	-0.304	0.011	-0.282	_	_
Bulk	D65/10	0.366	-0.264	-0.047	-0.249	102.02	Pass
	F11/10	0.379	-0.270	-0.149	-0.220	_	_
	A/10	0.422	-0.250	-0.025	-0.340	_	_

Table IV: Results of lab & bulk dyeing of cotton with Recipe- D

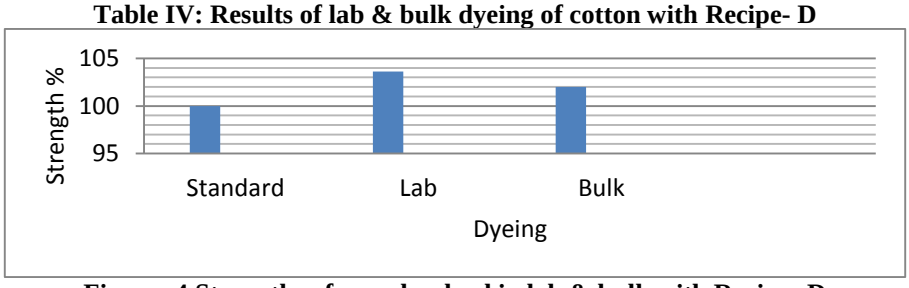

Figure: 4 Strengths of samples dyed in lab & bulk with Recipe- D

Cotton fabric samples were dyed in laboratories as well as in production. The dyed samples were evaluated for colour difference & strength. The samples were evaluated using different light source like D65, F11 & A at 10^0 observed. The results are given in Table- IV and represented in figure -4. It was observed that the fabric dyed in bulk was lighter than the fabric dyed in laboratory. This may be due to very good contact between fabric & dye liquor in soft flow machine. However, DE values of both the samples were close to standard sample.

RECIPE-E

Nova Blue FNR=0.086%
Nova Ruby S3B=1.296%
Nova Yellow TS3R=0.609%
Common Salt=40 g/lit
Soda ash =16 g/lit

Sample		DE	DL	DC	DH	Strength	Remarks
Standard		_	_	_	_	100	_
Lab	D65/10	0.351	-0.342	-0.023	0.071	104.71	Pass
	F11/10	0.352	-0.328	-0.040	0.119	_	_
	A/10	0.325	-0.319	-0.001	0.058	_	_
Bulk	D65/10	0.371	-0.361	-0.013	0.083	103.81	Pass
	F11/10	0.369	-0.345	-0.036	0.125	_	_
	A/10	0.343	-0.336	0.006	0.073	_	_

Table V: Results of lab & bulk dyeing of cotton with Recipe- E

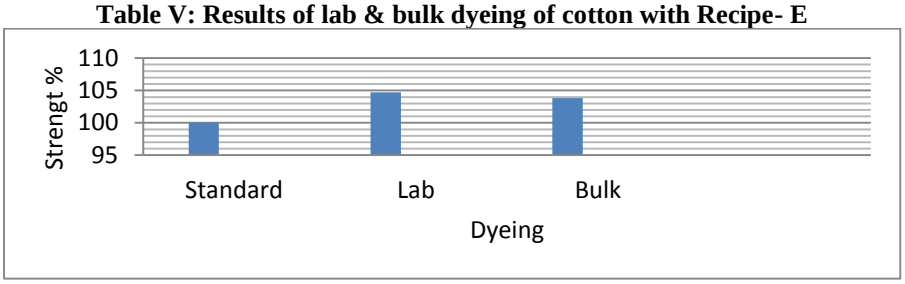

Figure: 5 Strengths of samples dyed in lab & bulk with Recipe- E

Cotton fabric samples were dyed in laboratories as well as in production. The dyed samples were evaluated for colour difference & strength. The samples were evaluated using different light source like D65, F11 & A at 10^0 observed. The results are given in Table-V and represented in figure -5. It was observed that the fabric dyed in bulk was lighter than the fabric dyed in laboratory. This may be due to very good contact between fabric & dye liquor in soft flow machine. However, DE values of both the samples were close to standard sample.

RECIPE-F

Nova Blue TS4C=2.748%
Nova Red TS3B=0.529%
Nova Yellow S3R=1.848%
Common salt=80 g/lit
Soda ash =20 g/lit

Sample		DE	DL	DC	DH	Strength	Remarks
Standard		_	_	_	_	100	_
Lab	D65/10	0.740	-0.340	-0.164	0.637	94.72	Pass
	F11/10	0.765	-0.343	-0.119	0.674	_	_
	A/10	0.914	-0.381	-0.038	0.830	_	_
Bulk	D65/10	0.860	0.058	-0.292	0.806	97.61	Pass
	F11/10	0.911	0.038	-0.322	0.851	_	_
	A/10	1.039	0.014	-0.136	1.030	_	_

Table VI: Results of lab & bulk dyeing of cotton with Recipe- F

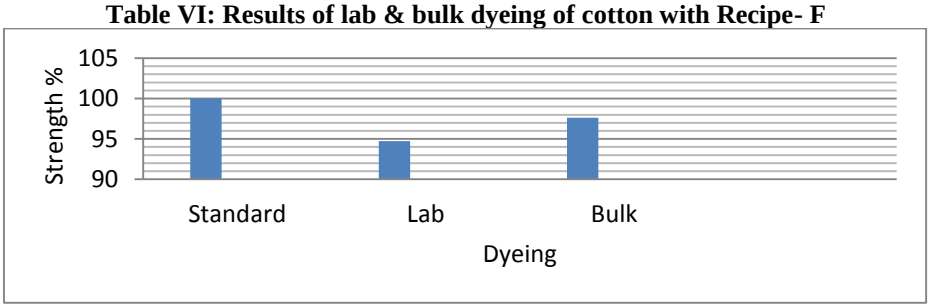

Figure: 6 Strengths of samples dyed in lab & bulk with Recipe- F

Cotton fabric samples were dyed in laboratories as well as in production. The dyed samples were evaluated for colour difference & strength. The samples were evaluated using different light source like D65, F11 & A at 10^0 observed. The results are given in Table-VI and represented in figure -6. It was observed that the fabric dyed in bulk was darker than the fabric dyed in laboratory. This may be due to very good contact between fabric & dye liquor in soft flow machine. However, DE values of both the samples were close to standard sample.

RECIPE-G

Polyester-

Colourline Blue XF=0.80%
Colourline Rubine XF=0.115%
Colourline Yellow Brown XF=0.124%

Cotton-

Amtex Blue HR2D=1.474%
Amtex Red HF3B=0.508%
Amtex Yellow HFGR=0.015%
Common Salt=50 g/lit
Soda ash =15 g/lit
Caustic=0.5 g/lit

Sample		DE	DL	DC	DH	Strength	Remarks
Standard		_	_	_	_	100	_
Lab	D65/10	0.392	0.296	0.186	-0.176	98.49	Pass
	F11/10	0.360	0.302	0.162	-0.110	_	_
	A/10	0.371	0.290	0.195	-0.124	_	_
Bulk	D65/10	0.423	0.295	0.170	-0.251	95.74	Pass
	F11/10	0.394	0.305	0.153	-0.197	_	_
	A/10	0.402	0.285	0.212	-0.188	_	_

Table VII: Results of lab & bulk dyeing of cotton with Recipe- G

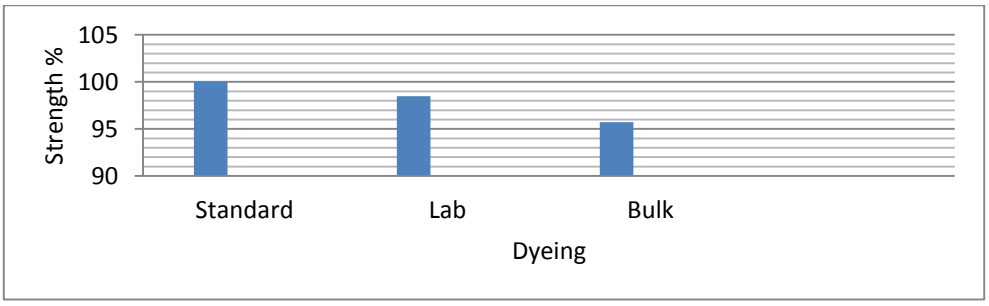

Figure: 7 Strengths of samples dyed in lab & bulk with Recipe- G

Cotton fabric samples were dyed in laboratories as well as in production. The dyed samples were evaluated for colour difference & strength. The samples were evaluated using different light source like D65, F11 & A at 10^0 observed. The results are given in Table-VII and represented in figure -7. It was observed that the fabric dyed in bulk was darker than the fabric dyed in laboratory. This may be due to very good contact between fabric & dye liquor in soft flow machine. However, DE values of both the samples were close to standard sample.

RECIPE-H

Polyester-

Colourline Blue GRXF-0.80%
Colourline Yellow XF-0.124%

Cotton-

Nova OGan SR=0.125%
Nova TuroECGN=2.420%
Nova Lemon S3G=1.000%
Common Salt=40 g/lit
Soda ash =16 g/lit

Sample		DE	DL	DC	DH	Strength	Remarks
Standard		_	_	_	_	100	_
Lab	D65/10	0.593	-0.445	-0.183	0.346	104.16	Pass
	F11/10	0.512	-0.397	-0.102	0.305	_	_
	A/10	0.597	-0.427	-0.037	0.416	_	_
Bulk	D65/10	0.579	-0.362	-0.264	0.367	106.10	Pass
	F11/10	0.517	-0.325	-0.221	0.336	_	_
	A/10	0.583	-0.345	-0.131	0.452	_	_

Table VIII: Results of lab & bulk dyeing of cotton with Recipe- H

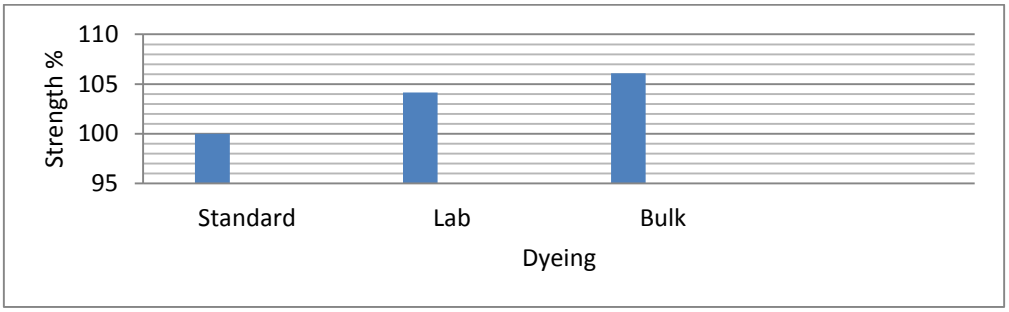

Figure: 8 Strengths of samples dyed in lab & bulk with Recipe- H

Cotton fabric samples were dyed in laboratories as well as in production. The dyed samples were evaluated for colour difference & strength. The samples were evaluated using different light source like D65, F11 & A at 10^0 observed. The results are given in Table-VIII and represented in figure -8. It was observed that the fabric dyed in bulk was darker than the fabric dyed in laboratory. This may be due to very good contact between fabric & dye liquor in soft flow machine. However, DE values of both the samples were close to standard sample.

CONCLUSION

Laboratory dyeing techniques, which are both accurate and repeatable to bulk, dyeing processes, are absolutely essential for the optimization of the production output and the cost effectiveness of the modern competitive dyeing operation. About 80% of the samples were match from lab to bulk. Samples which are dyed darker than the original require an extra wash in which 1-2 hours are wasted. Thus, right first time dyeing is very important in order to reduce the cost of production and in time delivery. If lab matching is failure, it cause re-dyeing and increase time and cost of dyeing in bulk and reducing the production in dyeing. The samples which were not matched with the original may be corrected by stripping and re-dyeing. This requires lots of time, water, chemicals, energy and ultimately money is wasted. Moreover such processes also harm the quality of the fabric.
The dyeing of cotton fabric is a fascinating and tremendous job in the textile processing, but with the help of proper guidance of dye selection, dye combination analysis, pre-diagnosis of dyeing machinery, dyeing auxiliaries the dyeing parameters can be optimized. The tensile strength, surface smoothness of cotton fabric can be significantly improved by the right establishment of kinetic dyeing thermodynamics and which leads to the Excellency of a new dyeing with almost zero defects in shade.

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