

Serial Number 18071

JLR-43-L, No. 24

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E. I. DuPont de Nemours & Company

Jackson Laboratory

September 29, 1942

Azo Lakes and Pigments

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A.A.B.

JLR-43-L, No. 24

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A.U.S.

E. I. DuPont de Nemours & Company

Jackson Laboratory

Azo Colors Division

S. S. Rossander

A.M.E.

Progress Report

September 29, 1942

Azo Lakes and Pigments

Group Leader - D. E. Kvalnes

Work Done By - H. E. Woodward

Work Started - March 1, 1942

Reported By - H. E. Woodward

Completed - July 30, 1942

J. M. TINKER,

ASST. DIRECTOR

W. S. CALCOTT,

DIRECTOR.

Azo Lakes and Pigments
(Project Number 422)

H. E. Woodward

JLR-43-L, No. 24

Serial Number 18071

Object of the Investigation:

The discovery of new azo compounds with superior properties, which might be desirable additions to our line of pigments and lake colors.

Period Covered by this Report:

March 1 to July 30, 1942.

Historical Background:

In the previous report on this project the following interesting products were reported.

A preliminary sample was requested of the red pigment - 2-amino-6-chlortoluene → Naphthanil AS.

A preliminary sample was requested of the yellow pigment - 2-nitro-4-chloraniline → 2-methyl-3-chloracetoacetanilide.

Dichlorbenzidine → (2-methyl-3-chlor-acetoacetanilide)₂ is a possible outlet for 2-nitro-6-chlortoluene, being close in shade, strength and fastness properties to Lithosol Yellow G Conc.

Dichlorbenzidine → (aceto-acetyl-o-amino-diphenyl)₂ and dichlorbenzidine → (aceto-acetyl-pseudocumidine)₂ are slightly superior to Lithosol Yellow G Conc. in light fastness.

Yellow pigments from 2,5-2'5'-tetrachlorbenzidine have very good light fastness but are weak tinctorially.

A preliminary sample was requested of the non-migrating reddish yellow pigment, 3,3'-diphenyl benzidine → (aceto-acet-anilide)₂ for testing in rubber.

A preliminary sample was requested of the Bordeaux toner 2-amino-4-chlortoluene → 2-hydroxy-3-naphthoic acid, nickel salt, which has very good light fastness.

Preliminary samples were requested of the manganese, cobalt and nickel salts of Tobias acid → R-salt, all of which are maroons in masstone and show very good fastness to light.

The manganese, nickel and cadmium toners of Lithosol Red 2B are slightly superior to the standard calcium toner in fastness to light.

The manganese toner of 2-sulfo-3-amino-6-chlortoluene → 2-hydroxy-3-naphthoic acid is of some interest as an outlet for 2-nitro-6-chlortoluene.

Several metal complex compounds of very good light fastness were found, but they are too dull to be of much interest.

Conclusions:

The strong, light-fast greenish-yellow pigment 2-nitro-4-chloraniline → 2-methyl-3-chlor-acetoacetanilide, J-43-P-198, is approved by Technical Laboratory as a color for commercial exploitation, and our Sales Division has requested that we call it to their attention for manufacturing consideration after the war.

The fast-to-light manganese, cobalt and nickel toners of Tobias acid → R-salt, J-43-P-199, p.200, p.201 are of some interest in lacquers and paints and they are undergoing outdoor exposure tests.

The red pigment 2-amino-6-chlortoluene → Naphthanil AS, J-43-P-205 (alkaline coupling) and J-43-P-206 (acid coupling) is of interest as a substitute for Toluidine Toner. Final samples of both couplings were requested and a new project was taken out for this work.

The red lake color 2-sulfo-3-amino-6-chlortoluene → 2-hydroxy-3-naphthoic acid, J-43-P-209, was not considered of interest by Technical Laboratory as long as present standard colors are available.

The red lake color 2-amino-6-chlortoluene → R-acid. J-43-P-214, was not of interest to Technical Laboratory as a substitute for Lithosol Scarlet 2R, because of weakness.

Summary:

The following preliminary samples were made -

- J-43-P-198 - 2-Nitro-4-chloraniline → 2-methyl-3-chloracetoacetanilide, a strong greenish yellow.
- J-43-P-199 - Tobias acid → R-salt, manganese toner, a fast-to-light red.
- J-43-P-200 - Tobias acid → R-salt, cobalt toner, a fast-to-light red
- J-43-P-201 - Tobias acid → R-salt, nickel toner, a " " " red.
- J-43-P-205 - 2-Amino-6-chlortoluene → Naphthanil AS, powder
- J-43-P-205A - " " → " " , paste
- J-43-P-206 - 2- " " → " " , a possible substitute for Toluidine Toner.
- J-43-P-209 - 2-Sulfo-3-amino-6-chlortoluene → 2-hydroxy-3-naphthoic acid, a red lake color derived from 2-nitro-6-chlortoluene.

*Collected as K-1640
Cf. Report K-42-152
Also K-1843
Humphreys
to be sent to J. H. H. H.*

*Cf. K-1640
K-1641
(H. H. H.)*

*But note H. H. H.
results on
K-1673*

*Cf. our
RE-542-D
(K-1729)*

- J-43-P-210 - 3,3'-Diphenylbenzidine → (acetoacetanilide)₂ a reddish yellow rubber color which is a possible replacement for two rubber yellows - Rubber Yellow RD and Rubber Yellow CG (Chro e Yellow of Krebs) now in our line.
- J-43-P-214 - 2-Amino-6-Chlortoluene → R-salt, a red lake color found by Krebs to be a desirable substitute for Lithosol Scarlet 2R. *If lakes correctly.*

Some further process work was done on two pigments -

- 1 - 3,3'-Dichlorbenzidine → (2-methyl-3-chloracetoacetanilide)₂ a derivative of 2-nitro-6-chlortoluene which is somewhat like Lithosol Yellow G Conc. *cf. K-1764*
- 2 - 2-Amino-4-chlortoluene → 2-hydroxy-3-naphthoic acid, nickel toner, which is a fast-to-light bordeaux or maroon.

New pigments of the following types were made and tested.

- 1 - Monazo pigments
- 2 - Disazo and polyazo pigments
- 3 - Metallized pigments with no metallizing group on the diazo component.
- 4 - Metallized pigments with metallizing group on the diazo component.

Patent Status:

A patent memorandum OR-1507 was prepared on decorative and protective coating compositions colored with the pigment 2-amino-6-chlor-toluene → Naphthanil AS. *Hummer & Co. Inc. AS.*

The patentability of other pigments mentioned in this report has not been investigated.

Plans for Future Work:

- 1 - Make a preliminary sample of the fast-to-light bordeaux 2-amino-4-chlortoluene → 2-hydroxy-3-naphthoic acid, nickel toner.
- 2 - Evaluate available intermediate when they offer a possibility of lowering costs or improving properties or using by-products.
- 3 - Continue the investigation of Naphthanil pigments to improve fastness properties.
- 4 - Continue the investigation of co-valent metal azo pigments, looking for colors of unusual light fastness.
- 5 - Evaluate lakes of other hydroxy-naphthoic acids than 2-hydroxy-3-naphthoic acid.

Experimental Results:

I. Further Work on Colors Previously Reported

A. J-43-P-198 - 2-Nitro-4-chloraniline → 2-methyl-3-chloracetoacetanilide. This greenish yellow pigment, which is similar to Lithosol Fast Yellow 10G (2-nitro-4-chloraniline → o-chloracetoacetanilide) but twice as strong, was discussed at the Azo Lakes and Pigments Conference of February 19 and a preliminary sample was requested. It was reported on Technical Laboratory Memo. 368-J as follows -

	Krebs YT454D	Lithosol Fast Yellow Y	Lithosol Fast Yellow HL
Masstone	Darker	Darker	Greener
Tint	Redder, Duller	Greener, Bright- er	" , Brighter
Strength	46:100	125:100	135:100
Oil and Alcohol Bleed	v.Sli. Inf.	Sli.Sup.	Sli.Sup.
Overstripe	Sli.Sup.	Much Sup.	Sli.Sup.
Light Fastness, Tint	Equal	" "	Much "

AS + ERA
note

The report stated, "This color is a strong greenish yellow of such interest that we recommend its addition to our line." The coupling component is a derivative of 2-nitro-6-chlor-toluene, and the Intermediate Processes Division has developed an economical process for making it. *this later found was not to be very different from other ones*

B. J-43-P-199, -P-200, -P-201 - Tobias acid → R-salt, manganese, cobalt and nickel toners. The original samples of these toners, although showing excellent light fastness, were rather weak and dull. It was found that they could be improved considerably in brightness and strength by precipitating at 60° or higher in the presence of about 160 parts of para soap per mole and holding at 90° for 1/2 hour or longer before filtering. These preliminary samples were made and reported as follows against a barium lake of Lithosol Scarlet 3BI (anthranilic acid → R-salt.)

	P-199 (Mn)	P-200 (Co)	P-201 (Ni)
Masstone	Dark Brown	Sli.Darker	Sli.Darker
Tint	Yellow, v.Dull	Yellow, v.Dull	Yellow, Duller
Strength	100:44	100:60	100:44
Water Bleed	Inf.	Equal	Inferior
Alcohol	Sl.Inferior	V.Sli.Inf.	M. "
Oil	M.Superior	M.Superior	Sli.Superior
Soap	Inferior	Sli.Sup.	Sli. "
Fadeometer			
Masstone (100 hrs.)	"	Superior	Superior
Undertone " "	Equal	"	"
Tint (75 hrs.)	"	Equal	Equal

These samples were also made into water dispersible powders by W&P milling a mixture of 40% toner, 50% dextrin and 10% leukanol, and tested in paper dyeing against Lithosol Red CSP as follows -

Shade - Consid. Yellower, Somewhat Brighter
 Strength - 170:100
 Light Fastness - Much Inferior

One of the water dispersible samples (nickel toner) was also tested in wall paper coating against Sulfanthrene Pink SV Paste, with the following results -

Shade - Yellow, Slightly Dull
 Strength - Weaker - 120:100 (Equal Color Basis)
 Light Fastness - Heavy Tint - Sli. Superior
 Weak " " "

C. J-43-P-205 - 2-Amino-6-chlortoluene → Naphthanil AS
 This sample was made by coupling in sodium hydroxide solution in the presence of 10 parts of rosin per mole. It was tested against Krebs Toluidine Toner, RT 386D and reported as LM-528J.

<u>Ink Tests</u>	Masstone	Darker
	Tint	V. Yellow and light 100:140
	Water Bleed	Superior (v.v. Sli. Bleed)
	Alcohol	Sli. Inf. (Medium ")
	Oil	V. Sli. Sup. (" ")
	Soap	Equal (" ")
	Fadeometer, Masstone	Inferior at 135 hours
	" , Tint	Much " at 80 hours

<u>Lacquer Grind</u>	Masstone	Lighter, slightly brighter
	Tint	Sli. Yellower, brighter, slightly strong
	Overstripe	Equal

<u>Dulux Grind</u>	Masstone	Very slightly flat
	Tint	Yellow and strong

For final sample of this color JLR-43-450, No. 1

D. J-43-P-205A - Paste sample of above. This sample was prepared in order to test the possibility of making use of the extra strength of this pigment. A 62.5% rosinated lake and a 67.5% aluminum hydrate lake were prepared and tested against RT386D.

		<u>Rosin Lake</u>	<u>Aluminum Lake</u>
<u>Ink Tests</u>	Masstone	Sli. Darker	Sli.Dark, Sli.Brown
	Tint	V.Yellow	V.Yellow
	Water Bleed	Equal	Equal
	Alcohol "	Equal	Equal
	Oil "	"	"
	Light		
	Fastness	Close	Close
<u>Lacquer</u>			
<u>Grind</u>	Masstone	Lighter and Brighter	Lighter and Brighter
	Tint	Brighter	Brighter
	Strength	Equal	Equal
	Overstripe	V.Sli.Inferior	V.Sli.Inferior

Outdoor exposure tests on lacquered panels are not completed so it can not be stated at present whether the extended product is satisfactory.

E. J-43-P-206 - 2-Amino-6-Chlortoluene → Naphthanil AS.
This sample was made by acid coupling with sodium acetate buffer at 60°. Compared with J-43-P-205 it is much bluer and slightly weaker, through the reported strength against toluidine toner is better. The comparison against RT386D, as reported on LM717J is as follows:

<u>Ink Tests</u>	Masstone	Slightly lighter and brighter
	Tint	Bluer and brighter 50:100
	Water Bleed	Slightly superior
	Alcohol "	Equal
	Oil "	Slightly inferior
	Fadeometer	V.Sli.inferior
<u>Lacquer</u>		
<u>Grind</u>	Masstone	Sli.yellower, slightly brighter
	Tint	Bluer and slightly stronger
	Overstripe	Equal

For final sample of this color see JLR-43-450.

F. J-43-P-209 - 2-Sulfo-3-amino-6-chlortoluene → 2-hydroxy-3-naphthoic acid. In the last report on this project it was stated that this color would be of interest in case of a shortage of derivatives of p-toluidine used in lake colors. Laking experiments showed that the quality of the toners could be improved by the use of para-soap or rosin in the precipitation of the calcium or manganese salts. Accordingly a preliminary sample of the sodium salt in paste form was submitted to Technical

Laboratory and reported on LML001J. A rosinated calcium lake compared with Krebs RT455D (a rosinated calcium lake of Lithosol Red 2B).

Masstone - Slightly Darker - Slightly Superior at 74 Hrs.
Tint - " - Bluer - Inferior at 50 Hours

Unless outdoor exposure tests on paint panels show some advantage this lake color is not of interest as long as present standards are available.

G. J-43-P-210 - Diphenylbenzidine → (acetoacetanilide)₂.
The preliminary sample previously requested has been made, but the Rubber Laboratory has not yet reported on it.

H. J-43-P-214 - 2-Amino-6-Chlor-Toluene → R-Salt
This lake color was found by Krebs to be of interest as a replacement for Lithosol Scarlet 2R, (m-xylydine → R-Salt), so a preliminary sample was made for examination by Technical Laboratory. The comparison against Lithosol Scarlet 2R was reported on LML412J.

Masstone	Much Lighter
Tint	" Yellower 127:100
Water Bleed	Slightly Superior
Alcohol "	" "
Oil "	" "
Fadeometer (7 Hrs.)	" "

Since it is planned to offer 2-amino-6-chlortoluene for sale, Technical Laboratory is not interested in further work on this color.

I. 3,3'-Dichlorbenzidine → (2-Methyl-3-Chloracetoacetanilide)₂. Some further work was done on this color in cooperation with Dr. Cooper of Krebs. It was found that this pigment is very sensitive to over-drying. When carefully dried it is darker in masstone than Lithosol Yellow G Conc. and close in tint, but on further heating after it is dried it becomes much lighter in masstone and redder and weaker in tint. We are not interested in this color as it would cost a few cents more than Lithosol Yellow G Conc. allowing recovery cost for 2-nitro-6-chlortoluene.

J. 2-Amino-4-chlortoluene → BON, nickel toner. The brightness of this pigment in inks has been improved so that it is now about equal in this respect to Lithosol Bordeaux BL. This improvement results from the use of 80 parts per mole of color and heating the suspension of the sodium salt to 90° before addition of the nickel chloride. Lacquered panels of this color are on the outdoor exposure rack and the preparation of a preliminary sample is awaiting the results of this test.

// RT 6 RA
NOTE
Sole was build up
last 4 heard AS

Interesting
One cent more
too high too

II. New Pigments

A. Monazo

	Page	Diazo	Coupler	Standard	Masstone	Tint	Tint Fade- Ometer	Oil Bleed
K-1610	106A	2,5-Dichlor-aniline	Naphthanil AS		Lt. Red	Blue Red	Fair	Good
RT-536-D	B	"	" ASD	Dk.	"	Yel.	"	"
	107A	"	" MX	"	"	Weak	"	Fair
	B	"	" PC	"	"	"	Fair	"
	C	"	" RL	"	"	Yel.	"	"
	D	"	" OL	Lt.	"	"	Fair	"
	53A	2-Amino-6-Cl-Toluene	BON-2-Amino-Diphenyl		"	Orange	Poor	Poor
	B	"	BON-p-amino-phenylmethyl sulfone	Dk.	"	Bluish	Poor	Good
	79	"	BON-2-amino-6-Cl-Toluene	Dull	"	Orange	Poor	Good
	80	2-Amino-4-Cl-Toluene	"	Deep	"	Red	Poor	Good
	81	2,5-Dichlor-aniline	"	Dull	"	Orange	"	"
	85	2-Amino-4-Cl-Anisol	"	Brown		Dull Red	"	"
	86	2-Nitro-4-Cl-Aniline	"	Red		Red	Fair	"
	87	3-Nitro-4-Amino-Toluene	"	Dk. Red		Bordeaux	"	"
	90	2-Amino-4-Nitro-Tol.	"	Lt.	"	Yel. Red	"	"
	91	2-Amino-4-Nitro-Anisol	"	"	"	"	"	"
	84	alpha-Naphthl-amine	"	Black		Dull Maroon	Poor	"
	18	3-Nitro-4-aminocumene	AAA	Yel. 10G	S.Redder	Close	M.Inf.	Inf.
	119A	3-Nitro-4-aminoanisol	AAA	F.Or-ange G	M.Yellower	M.Yellower	S.Inf.	Equal
	D	3-Nitro-4-aminoanisol	AA-p-phen-etidine	"	M.Redder	M.Redder	Sup.	Equal
	139	3-Nitro-4-aminotoluene	AA-p-amino-phenylmethyl sulfone	F.Yel-low HL	M.Greener	Greener, Weaker	Inf.	Equal
	64	PNA	5-Hydroxy-benzo2,1,3-thiodiazo		Lt.Brown	Dull Or.	Poor	

*Yes RT-536-D (a 10-quin.) is included,?
 Reimportance of outdoor exposure test.*

None of the preceding pigments is of much interest. The sample 3-nitro-4-aminoanisole → acetoacetyl-p-phenetidine has good light fastness, but it is dominated by U.S. Patent 1,595,269.

B. Disazo and Polyazo

Page	Diazo	Coupler	Standard	Masstone	Tint	Tint Fade- Ometer	Oil Bleed
3C	2,7-Diamino-xanthone	beta-Naphthol	RT232D	M.Yellower	M.Yellower	Equal	Equal
3D	"	Naphthanil	AS RT399D	Lighter	M.Bluer	Inf.	"
45C	2,7-Diamino-fluorene	"		Blue	Blue	Poor	
138B	2,3,2'3'tet-rachlorbenzidine	AA-p-phenetidine	Yel.G	Dark and Dull	Green and Weak	Equal	M.Inf.
44A	2,5,2'5'tet-rachlorbenzidine	AA-o-toluidine	"	Duller	M.Weaker	Sl.Sup.	
44C	"	AA-p-	"	"	Grn.,Weak	"	"
44D	"	" phenetidine	"	Dk.,Dull	M.Weaker	"	Equal
69	Dianisidine	AA-p-phenyl-methylsulfone	OrangeF	M.Darker	M.Duller	M.Inf.	"
128A	Bithioanisidine	AAA		Lt.Brown	Dull Yel.	Poor	V.Sli.
60A	Bi-cresidine	AAA	Yel.G	Lighter	M.Weaker	M.Inf.	Equal
129A	Dinitrodiaminodiphenylsulfone	"	Yel.G	Duller	Dull,Wk.	S.	"
3A	2,7-Diamino-xanthone	"	Yel.G	M.Lighter	M.Weaker	"	"
45A	2,7-Diamino-fluorene	"		Brown	Yel.Brwn.	V.Poor	
128B	Bi-thioanisidine	PMP		Lt.Brwn.	Dull Or.	"	Slight
60B	Bi-cresidine	"	OrangeF	M.Yellower	M.Yellower	Inf.	S.Inf.
129B	Dinitrodiaminodiphenylsulfone	"	Yel.G	M.Redder	Tan	Tr."	N.B.
59	2,2'Dichlor-4,4'diaminostilbene	"	OrangeF	M.Darker	Redder	Equal	S.Inf.
3B	2,7Diaminoxanthone	PMP	"	OT Darker	M.Yellower	"	Inf.
45B	2,7 " fluorene	"		Red Brwn.	Red Brwn.	Poor	
102A	Tetraamino	CPC 1,4Oxy Acid		Black	Gray,Wk.	Fair	
22A	"	Schaeffer	"	"	"	"	
103A	"	J-Acid		"	" ,Str.	"	
21A	"	8-Hydroxyquinoline		"	"	Poor	

None of the preceding pigments is of interest.

C. Metallized, -No Metallizing Group on the Diazo Component

Page	Diazo	Coupler	Metal	Masstone	Tint	Fadeometer	
						Mass- tone	Tint
65A	PNA	Aniline	Ni	Dull Red	Orange	Poor	Poor
65B	"	"	Cu	Red Brown	Dull "	"	"
64B	"	5-Hydroxyben- zothiodiazol	Ni	Olive "	Khaki	"	"
64C	"	"	Cu	Black	"	Fair	Fair
12A	m-Nitro- aniline	5-Methyl-8- Hydroxyquin- oline	Ni	Dark Brwn.	Red Brwn.	Good	Poor
12B	"	"	Cu	"	Tan	"	V. "
71	Aniline	4-Hydroxy- quinoline	Cu	"	Brown	Good	Poor
52A	p-Chloraniline	1,3-Dihydroxy- pyrido	Ni	Light	" V.Weak	"	Fair
B	"	(4,3b)quino- line10(5)one	Cu	Dark	" Khaki	"	V.Poor
10A	Benzidine	8-Hydroxy- quinoline	Ni	Black	Gray	"	"
10B	"	"	Cu	"	"	"	"
13A	"	5-Methyl-8- Hydroxy- quinoline	Ni	"	Dull Blue	Poor	"
13B	"	"	Cu	"	Red Brwn.	Fair	V.Poor
45D	2,7-Diamino- fluorene	2,4-Dihydroxy quinoline	Cu	"	Viol. "	"	"
23B	Tetraamino CPC	beta-Naphthol	Ni	"	Gray Strong	Good	Fair
D	"	"	Cu	"	"	"	"
22B	"	Schaeffer	Ni	"	"	Fair	"
C	"	"	Cu	"	"	"	"
102B	"	1,4-Oxy Acid	Ni	"	"	Good	"
102C	"	"	Cu	"	"	"	"
103B	"	J-Acid	Ni	"	"	"	"
103C	"	"	Cu	"	"	Fair	"
20B	"	PMP	Ni	Dark Grn.	Dull Green	Good	"
20D	"	"	Cu	"	"	"	Poor
21B	"	8-Hydroxy- quinoline	Ni	Black	Gray	"	Fair
21D	"	"	Cu	"	"	Fair	Poor

None of the above pigments is of interest.

D. Metallized - With Metallizing Group on the Diazo Component

Page	Diazo	Coupler	Met-	Masstone	Tint	Fadeometer	
						Mass-	Tint
						tone	
140A	Anthranilic Acid	p-Chlorphenol	Co	Black	Gray	Good	Poor
B	"	"	Ni	"	Lt. Brown	Fair	Fair
C	"	"	Cu	Dk. Brown	Maroon	"	Poor
141A	"	Resorcin	Co	Black	Gray	"	Fair
B	"	"	Ni	"	Gray	"	Good
C	"	"	Cu	Dk. Brown	Wk. Brwn.	"	Poor
142A	"	Naphth. MX	Ni	Black	Wk. Mar.	Poor	Poor
D	"	"	Cu	Dk. Maroon	Maroon	Fair	Poor
144A	"	" BS	Ni	Black	V. Weak	Good	"
D	"	"	Cu	Dk. Maroon	Maroon	"	"
145B	"	" RL	Ni	" "	Dull Vi.	"	Good
D	"	"	Cu	" "	Maroon	"	Poor
68C	"	" oA	Cu	Maroon	Brown	Fair	Poor
D	"	" SW	Cu	Dk. Maroon	Bordeaux	"	"
143A	"	" BO	Ni	" "	Dull Vi.	"	Good
D	"	"	Cu	" "	Brown	"	"
14A	2-Amino-4-Cl-Benzoic Acid	" AS	Co	Black	Gray	Good	"
B	"	"	Ni	"	Wk. Maroon	Fair	Fair
C	"	"	Cu	Dk. Brown	" "	Fair	Poor
16A	2-Amino-5-Cl-Benzoic Acid	"	Co	Black	Gray	Good	"
B	"	"	Ni	Dk. Brown	Dull Vi.	"	Fair
C	"	"	Cu	" "	Dull Mar.	"	Poor
17A	"	"	Co	" "	Gray	"	"
B	"	"	Ni	" Maroon	Maroon	"	Good
C	"	"	Cu	" "	Brown	"	Poor
15A	2-Amino-6-Cl-Benzoic Acid	"	Co	Black	Gray	Good	Poor
B	"	"	Ni	Dk. Brown	Wk. Maroon	"	Good
C	"	"	Cu	Red Viol.	Red Viol.	"	Poor
51A	2-Amino-5-Nitro-Benzoic Acid	"	Ni	Black	Gray	Fair	Fair
B	"	"	Cu	Dk. Maroon	Maroon	"	Poor
134A	Anthranilic Acid	AA-p-Chlor-Aniline	Co	Brown	Tan	Fair	"
B	"	"	Ni	Lt. "	Dull Yel.	Good	Good
D	"	"	Cu	Dull Grn.	" Grn.	"	Fair
135A	"	AAoToluidine	Co	Dk. Brown	Olive Brn.	"	Poor
B	"	"	Ni	Lt. "	V. Weak	"	"
D	"	"	Cu	Dull Grn.	Dull Grn.	"	Fair
61A	"	PMP	Co	Olive Brn.	Olive Brn.	"	Good
B	"	"	Ni	Dull Yel.	Dull Yel.	"	"
C	"	"	Cu	Olive	Olive	"	"

11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040 1041 1042 1043 1044 10

Anthranilic acid → Naphthanil RL, Nickel Complex
 2-Amino-4-Chlorbenzoic Acid → Naphthanil AS, Cobalt Complex
 2-Amino-5-Chlorbenzoic Acid → Naphthanil ASE, Nickel "
 2-Amino-6-Chlorbenzoic Acid → Naphthanil AS, Nickel "
 Anthranilic Acid → Phenylmethylpyrazolone, Cobalt Complex
 " " " , Nickel "
 " " " , Copper "
 2-Amino-3-Naphthoic Acid → m-Nitrophenylmethylpyrazolone,
 nickel complex.

Some of these pigments were tested for beater dyeing of paper, as follows:

2-Amino-6-chlorbenzoic acid → Naphthanil AS, nickel complex (3795-15B), was compared with J-43-F-430D, (aniline → 2-hydroxy-3-naphthoic acid, nickel complex) and found to be slightly yellower, equal strength and much inferior to light fastness.

2-Amino-5-Chlorbenzoic acid → Naphthanil AS, copper complex (3795-16D), was found to be fast-to-acid and alkali and only very slightly affected by eradicator. It is slightly superior to Lithosol Red CSP in fastness-to-light. It is redder than the direct violets and faster-to-light.

Anthranilic acid → phenyl-methyl-pyrazolone, copper complex (3795-61D), compared with J-43-F-391 (PNA → DHQ, nickel complex) is much duller, but about equal in light fastness. It is of interest for camouflage papers and a larger sample was prepared for further tests (3795-146). The nickel complex (3795-61B) was inferior in light fastness to the copper complex.

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