The Dutch Method Unfolded

Masterclass on Wax-Resin Linings
Getty Foundation & University of Amsterdam
2021

WORKSHOP GUIDE

Contents

Workshop 3
Color change in ground reconstructions after wax-resin linings

1. Organizational details

Supervised by: Emilie Froment
Date: 8, 9 and 10 February
Location: Ateliergebouw, Amsterdam
Assistance: students from Master 1

2. Goals and teaching methods

The workshop aims at raising awareness on color change in paintings after wax-resin linings. Central to this workshop is the study of optical phenomena on reconstructions. The material and physical characteristics of the reconstructions were chosen in order to let the participants experience under which conditions and to what extent colors can be modified by wax-resin lining.

Tests on historical paintings were put aside on ethical grounds, since wax-resin impregnation is currently considered irreversible and therefore not supported by present-day conservation approaches. Furthermore, reconstructions allow factors of influence to be studied either independently or in combination, which was considered beneficial for the purpose of the workshop.

The session is supervised by professional conservators. The visual observations and the color measurements are discussed in collaboration with experts in the field. The small size of the reconstructions enables the participants to take it with them to their institute so that the effects of wax-resin linings can be shared with their colleagues, students and peers.

3. Overview of the reconstructions

The workshop focuses on color change in ground layers after wax-resin impregnation. Ground layers are vulnerable to color change and because of this were subject to recent research.[1] There are two types of reconstructions involved in the workshop which differ per type of canvas and ground. Variations in the grounds include: pigment composition, type of binding medium, pigment ratio, and layer thickness. In total sixteen different ground recipes were made for the workshop.

The majority of the ground types replicate as closely as possible material and physical characteristics of preparations found in seventeenth century Netherlandish paintings on canvas.

[1] See Appendix B and C.

The minerals components in the ground comprise chalk, iron oxides, umber, clay minerals, and quartz sand which were used independently or in combination. They were bound in either linseed oil or animal glue. In addition, a few reconstructions replicate grounds found in 19th and 20th paintings. These grounds consist of zinc white or titanium white in linseed oil from paint tube.[2] A ground composed of the two paints was also applied. For health reasons lead white was not used.

Pigments and pigment mixtures were mixed with the necessary amount of medium to obtain a suitable paste that could be applied onto the canvas with a brush. The pigments and binding medium were ground with glass muller and metallic pallet knife on a glass plate. The oil paint composed of zinc white or titanium white were used directly out of the tube and mixed with a palette knife.

In general, the grounds were applied with a brush, except for 2 strokes on series I canvas A and B that have been applied with a drawdown bar using a gap size at 50 μm and 200 μm. The later technique allows the participant to experience the effect of layer thickness on the degree of color change.

Series I

Series I counts three types of reconstructions: type A, B, and C. Every plain weaved linen canvas is laced to a wooden stretcher with ropes. The stretcher size is: 40 x 60 cm. in preparation the canvas is sized with liquid 10% animal glue. On type A, B and C eight different types of ground were applied in parallel strokes on the linen canvas. The types of ground differ according to pigment composition, pigment ratio, and type of binding medium in the ground as well as ground layer thickness and application method of the ground.

Series II

Series II reconstructions consists of three different types of ground applied on the same piece of plain weaved cotton canvas. The canvas is stapled to a wooden. The stretcher size is: 40 x 50 cm. The canvas is sized with liquid 10% animal glue.

[2] See for a detailed list of materials: Appendix A

4. Wax-resin treatment

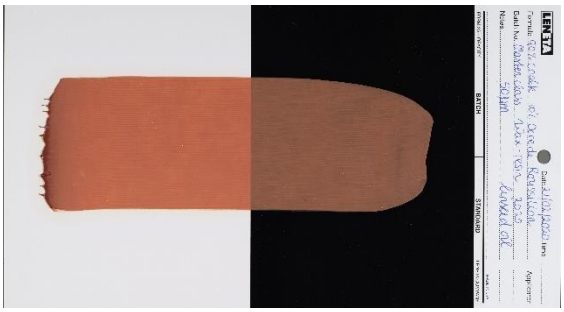
All the participants use a similar lining technique. Half of the canvas will be lined. This so that the color of the grounds before and after impregnation can be compared.

5. Opacity charts

An important aim of the workshop is to develop knowledge regarding the influence of the degree of hiding power to the extent of ground color change after wax-resin impregnation. In this purpose, each ground was applied on opacity charts at two different thicknesses of 50 μm and 200 μm. Through visual comparison and color measurements the charts will allow to assess the degree of hiding power of each ground. Results will support the understanding of the appearance of grounds after lining.

6. Color measurements

Analytical techniques used for the evaluation of the results will include color measurements with spectrophotometer and calculation of color change.



Form 2A, opacity chart, Leneta Co

Form N9A, opacity chart, Leneta Co

Series I Type A

	Number	Details	Application
	#1	6,6 g clay : 3,1 g quartz sand : 0,3 g raw umber in linseed oil	Brush
	#2	0,2 g red ocher : 9,8 g natural chalk in animal glue	Brush
	#3	5 g red ocher in linseed oil	Brush
	#4	0,2 gr. red ocher : 9,8 g natural chalk in linseed oil	Brush
	#5	0,1 g yellow ocher : 0,1 g raw umber : 9,8 g natural chalk in linseed oil	Paint film applicator 50 µm
	#6	0,1 g yellow ocher : 0,1 g raw umber : 9,8 g natural chalk in linseed oil	Paint film applicator 200 µm
	#7	10 g red ocher in animal glue	Brush
	#8	Rembrandt zinc white linseed oil	Brush

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Series I Type B

Note:

In panel B IV ground 2 and 7 are swapped by accident.

	Number	Details	Application
	#1	6,6 g clay : 3,4 g quartz sand in linseed oil	Brush
	#2	0,2 g tile red : 9,8 g natural chalk in animal glue	Brush
	#3	10 g tile red in linseed oil	Brush
	#4	0,2 g red tile : 9,8 g natural chalk in linseed oil	Brush
	#5	0,5 g yellow ocher : 0,5 g raw umber : 9 g natural chalk in linseed oil	Paint film applicator 50 µm
	#6	0,1 g yellow ocher : 0,1 g raw umber : 9,8 g natural chalk in linseed oil	Paint film applicator 50 µm
	#7	10 g red tile in animal glue	Brush
	#8	Rembrandt zinc white linseed oil	Brush

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Series I Type C

	Number	Details	Application
	#1	6,6 g clay : 3,1 g quartz sand : 1,5 g raw umber : 1,5 g yellow ocher in linseed oil	Brush
	#2	0,2 g red ocher : 9,8 g natural chalk in animal glue	Brush
	#3	1 g red ocher : 9 g natural chalk in linseed oil	Brush
	#4	1 g red tile : 9 g natural chalk in linseed oil	Brush
	#5	0,5 g yellow ocher : 0,5 g raw umber : 9 g natural chalk in linseed oil	Brush
	#6	0,1 g yellow ocher : 0,1 g raw umber : 9,8 g natural chalk in linseed oil	Brush
	#7	10 g red ocher in animal glue	Brush
	#8	Rembrandt zinc white linseed oil	Brush

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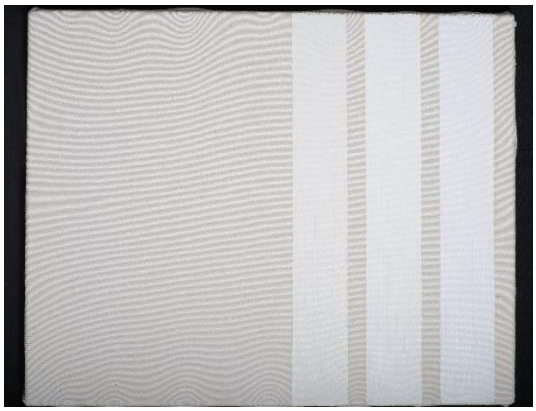
Series II



	Number	Details	Application
	#1	titanium white	Brush
	#2	50% titanium white : 50% zinc white	Brush
	#3	zinc white	Brush

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Appendix A: List of materials and instruments

Type of material	Information provided by the supplier	Details of the supplier	Product reference
Canvas			
Linen Brussel canvas	100% linen ± 275 g/m² Plain weave Unprepared	Van Beek Art Supplies Stadhouderskade 63 1072 AD Amsterdam Netherlands	119019
Cotton canvas	Cotton Duck		
Binding media			
Linseed oil	Cold pressed, may contain a small amount of mucilage.	Kremer Pigmente GmbH & Co. Hauptstrasse 41-47 88317 Aichstetten Germany	73054
Rabbit skin glue	Made from rabbit hide Form: grains.		63025
Pigments			
Natural chalk	Origin: Omey, Champagne, France Form: powder	Kremer Pigmente GmbH & Co. Hauptstrasse 41-47 88317 Aichstetten Germany	
Ball clay	05 bloem BLOEMISTENKLEI without chamotte Paste	Van Beek, Amsterdam Weteringschans 201 1017 XG Amsterdam Netherlands	468292
Tile red	100 year old roof tiles composed of Maas river clay. Grinded in the windmill De Kat, Zaandam.	Verfmolen de Kat Kalverringdijk 29 1509 BT Zaandam	
Quartz sand		Collection UvA studio	

Red ocher	Ochre de Roussillon	Collection UvA studio	
Zinc white	Rembrandt tube paint Student quality	Van Beek, Amsterdam Weteringschans 201 1017 XG Amsterdam Netherlands	
Titanium white	Rembrandt tube paint Student quality		
Yellow ocher	French Ochre	Collection UvA studio	
Raw umber	Raw Umber Cyprus	Kremer Pigmente GmbH & Co. Hauptstrasse 41 – 47 88317 Aichstetten Germany	40610
Form 2A, opacity chart, Leneta Co	Form 2A is a black and white sealed opacity chart. The top is black and the bottom is white with overall dimensions of 5-1/2 x 10 in (140 x 254 mm).	Leneta Company, Inc. 15 Whitney Rd. Mahwah, NJ, 07430 US www.leneta.com	
Form N9A, opacity chart, Leneta Co	Form N9A-2 is a black and white Unsealed Test Chart. The top most area is striped pattern, then black, then white with overall dimensions of 5-1/2 x 10 in (140 x 254 mm).		
Film applicator / draw down bar	Type: Filmograph baker; Width: sixty millimeters.	Elcometer B.V. Euclideslaan 259 3584 BV Utrecht Netherlands	3520

Appendix B: Recent research on color change in paintings after wax-resin linings

2019

Froment, Emilie. "The consequences of Wax-Resin Linings on the Present Appearance and Conservation of Seventeenth Century Netherlandish Paintings on Canvas." PhD dissertation, University of Amsterdam, 2019.
Available through: https://dare.uva.nl/search?identifier=38785f97-9204-4673-b047-2d9433577d46

2010

Watson, Meredith, Aviva Burnstock,… "Changes in the appearance of 19th century grounds on canvas upon varnishing and varnish removal." *New Insights into the Cleaning of Paintings: Proceedings from the Cleaning 2010 International Conference, Universidad Politecnica de Valencia and Museum Conservation Institute*, edited by Mecklenburg, Marion F., Charola, A. Elena, and Koestler, Robert J., 77–84. Smithsonian Contributions to Museum Conservation. Washington, DC: Smithsonian Institution.
Available through: https://repository.si.edu/handle/10088/20492

2011

Nieder, Emily, Ella Hendriks, and Aviva Burnstock. Colour Change in Sample Reconstructions of Vincent van Gogh's Grounds Due to Wax-Resin Lining. *Studies in Conservation*, 56 (2011): 94-103.
Available through: https://www.jstor.org/stable/42751903?seq=1#metadata_info_tab_contents

1994

Heydenreich, Gunnar. "Removal of a Wax-Resin Lining and Colour Changes: A Case Study." *The Conservator*, 18 (1994): 23-27.
Available through:
https://www.tandfonline.com/doi/abs/10.1080/01410096.1994.9995081?journalCode=rcon18

1985

Bomford, David, and Sarah Staniforth. "Lining and Colour Change: Further Results." *National Gallery Technical Bulletin* 9 (1985): 65-69.
Available through: https://www.nationalgallery.org.uk/research/research-resources/technical-bulletin/lining-and-colour-change-further-results

1981

Bomford, David, and Sarah Staniforth. "Wax-Resin Lining and Colour Change: An Evaluation." *National Gallery Technical Bulletin* 5 (1981): 58-65.
Available through: https://www.nationalgallery.org.uk/research/research-resources/technical-bulletin/wax-resin-lining-and-colour-change-an-evaluation

Appendix C: Quotes from paintings conservators, conservation scientists and curators on color change in paintings after wax-resin lining

(listed in chronological order)

Harold Plenderleith and Stanley Cursiter, "The Problem of Lining Adhesives for Paintings – wax adhesives," *Technical Studies in the Field of the Fine Arts* III-2 (1934): 98-99.

> "A point to be remembered is that pigments in which, through age, the binding property of the medium has to some extent perished may appear very different in colour from the same pigment when restored to their right content. Any change in the character of the original medium may also produce a change of colour pitch, so it may be important to ensure that the new binding medium -should it permeate the paint layer - does not differ in refractive index from the original medium. A wax-resin relining mixture may produce a heavy leaden appearance unless precautions are taken to treat pigments which have become porous with some other binder, applied on the surface before relining is started."

Stanley Cursiter and A. Martijn de Wild, "Picture Relining," *Technical Studies in the Field of the Fine Arts* V-3 (1937): 167 and 170.

> "[i]f the paint layer is in an absorbent condition, it may have to be impregnated with some medium analogous to that originally used in producing the picture. This is very important and may be particularly needful in the case of pictures where, as in many modern works, portions of the ground are left exposed between the touches of paint. If the wax mixture penetrates these exposed portions of the ground, they are almost certain to go lower in tone and so alter their relation to the superimposed or adjoining touches of pigment. This question of altered values, due to change in the refractive index of the mediums or to impregnation with mediums of a character differing from those originally used, is a frequent source of distortion in the colour values of restored pictures."

Anonymous, *Manual on the Conservation of Paintings* (International Council of Museums, 1940; repr., London: Archetype Publications, 1997), 213, 217 and 218.

> "[the lining adhesive in general] should at the same time, preserve the canvases from disintegration without altering the optical properties of the ground or of the paint layer."
>
> "Another advantage of a glue adhesive is that it interferes but very little with the optical properties of most primings (reflecting power). Wax, on the other hand, would slightly reduce the reflecting power of a more or less absorbent white priming, and thus darken somewhat a transparent painting executed on such a ground. In the case of an oil painting, the wax which penetrates the paint layer or which even spreads over its surface through the crackle would reduce the depth (transparency) of the colours a little, and thus make the darker tones appear a shade lighter and duller. In an old master - a Rembrandt or a Titian, for example - this loss of transparency would alter the effect originally intended by the artist. Moreover, as mentioned above, a varnish applied to a painting in such a condition would not retain its transparency and would tend to crackle."

"These drawbacks can, however, be met by adding a little resin, as a hardening ingredient, to the wax. Rosin (colophony) is generally used for this purpose and has so far proved very useful. In inferior grades, it has the disadvantage, of being rather dark so that for bright paintings, or for pictures where the white priming plays an important part, none but the clearest quality should be used."

Christian Wolters, "The Care of Paintings: Fabric paint supports," *Museum* XII-3 (1960): 143.

"Some experts fear that this process may change the appearance of the colours in the painting because it causes an increasing transparency, which mainly affects the ground layers and which cannot be reversed. (This technique cannot of course be used for pictures painted in distemper.) Various objections have also been raised concerning the restricted air circulation, and even impermeability thus occasioned. Other experts, on the contrary, consider that wax impregnations by no means cause total impermeability and do not affect the transparency of oil colour. Apparently little use is made of impregnations with a synthetic resin base. In theory they would be excellent, but their effects, unlike those of wax, are not as yet fully known and it is feared that they might be irrevocable. Some experts have pointed out that it is not possible to remove wax completely."

Westby Percival-Prescott, "The lining Cycle: Causes of physical deterioration in oil paintings on canvas: lining from the 17th century to the present day" in *Lining Paintings: Papers from the Greenwich conference on comparative lining techniques,* ed. Caroline Villers (London: Archetype Publications, 2003), 11.

"The wax-impregnation method is in very common use in countries in the Western world. Thousands of paintings have been lined or impregnated with the use of wax-resin mixtures. Not all of the paintings treated have fare well. In some cases, the tonal drop is almost a blackening effect, where the ground or the priming has been of such a colour to become considerably darker and thus the colour values of the original painting are sometimes savagely altered.

The dangers of a change in tone of the paint caused by the infusion of wax or wax-resin have only recently been redefined. The rough rule of thumb criteria that oil paintings will take a wax-resin impregnation, while tempera or gouache paintings will not, no longer wholly serves, for some oil paintings are almost as radically changed as tempera paintings by wax-impregnation method…We have also seen that many of the so-called 'oil grounds' are (if of the type recommended by De Mayerne) of a non-homogeneous structure and these grounds too, can easily be affected by penetration of the open cavities inherent in the structure of the material.

However, the use of gypsum, chalk and fillers was not confined to the ground and priming layers, but was often a regular component in the white paint layers of the picture, forming, with the lead carbonate, a light semi-opaque paint with increased colour 'staining power' (30).

The adulteration of lead white with chalk was also common during the 17th century as it is today and chalk continues to be a regular ingredient in artists' paints. Impregnation with wax or wax-resin can alter the vehicular balance of paint layers and lower the relative refractive index in such a way as to bring perceptible changes of tone and quality to the

paint layer. Sadly, this principle which was so clear to Muntz was not recognized by later restorers in the 19th and early 20th centuries."

"(30): High opacity whites have high stain (or tinting) resistance; low opacity whites have low stain resistance. This factor was made use of by painters in the 17th century who commonly employed two whites."

Gustav Berger and H.I. Zeliger, "Wax Impregnation of Cellulose: An irreversible process," in *Lining Paintings: Papers from the Greenwich conference on comparative lining techniques,* ed. Caroline Villers (London: Archetype publications, 2003), 26.

"To date, the following effects of all waxes on the components of easel paintings have been noted:

6. Staining of canvas on application.
7. Staining of absorbent paint films and priming on application."

Robert E. Fieux, "Consolidation and Lining Adhesives Compared" in *Lining Paintings: Papers from the Greenwich conference on comparative lining techniques,* ed. Caroline Villers (London: Archetype publications, 2003), 36.

Table 1 Comparison table for criteria.

Criteria	Wax-resin	Beva 371	PVA	Aqueous glue
Color staining	Yes	No	No	Not as demonstrated, but might

George Messens, "Hand Lining with Wax-Resin Using an Iron," in *Lining Paintings: Papers from the Greenwich conference on comparative lining techniques,* ed. Caroline Villers (London: Archetype publications, 2003), 70.

"Before describing this method of lining paintings, I would like to say that it is a pity in all cases to have to line, for even if the treatment is carried out well with precision and care, a slight change is always noticeable."

Gustav Berger and H.I. Zeliger, "Detrimental and Irreversible Effect of Wax Impregnation on Easel Painting," in *Preprints Meeting ICOM-Committee for Conservation 4th triennial Meeting Venice (*Paris: ICOM, 1975), 75/11/2-1- 15;

"After lining it was no longer the old painting because all its colour values were insidiously changed. Recent research has shown wax impregnation of paintings to be irreversible. Six researchers in Europe and United States have independently of each other provided objective scientific proof that 1. Wax stains and discolours many paint films and grounds, 2. Many wax-resin mixtures are prone to discoloration."

Ségolène Bergeon, *Science et patience ou la restauration des peintures* (Paris: Réunion des Musées Nationaux, 1990), 46, 57 and 58.

"On reproche aussi à cette methode d'introduire un matériau à base de cire qui, emplissant tous les vides, rend un peu ivoire les preparations blanches poreuses, assombrit les

preparation colorées si elles sont poreuses, et serait difficilement éliminé ultérieurement ce qui rendrait le procédé non reversible."

"D'autre part seules les preparations poreuses, claires ou non, sont transformées, mais les preparations non poreuses, meme blanches ne sont pas assombries, ce qui enlève aux détracteurs de la methode une grande partie de leurs arguments."

"La couche colorée composant les chairs, les vêtements, les feuillages et le ciel était assez couvrante pour le pas craindre dans le cas de la cire résine l'éventuel léger assombrissement de la preparation (faible car affectant surtout la couche profonde, mais peu la seconde preparation ne provoquât un assombrissement de la composition."

David Bomford, "The conservator as narrator: changed perspectives in the conservation of paintings," in *Personal viewpoints: thoughts about paintings conservation*, ed. Mark Leonard (Los Angeles: Getty Conservation Institute, 2003), 4 and 5.

"The Nineteenth-century painting in question is Camille Pissaro's *Fox Hill*…I consulted with colleagues and concluded that the painting was structurally weak: I wax-lined the painting on a vacuum hot table and remounted it on its original stretcher. This was a treatment that was completely in line with normal practice in the mid-1970s. It was routine operation that took just a few hours to carry out. We were, of course, aware of the possible drawbacks of wax lining – darkening of exposed areas of priming and unwanted texture changes – but *Fox Hill* appeared unaffected by its treatment."