“Historically” informed reconstructions of 19th century chrome yellow pigments

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Abstract

This report deals with the fabrication of 19th century historically informed chrome yellow pigments by Vanessa Otero and Gauthier Patin in April 2019. In the time frame of five days, about 44 g of pigments have been made. The majority of the pigments will be used to paint a reconstructed version of the Sunflowers painting from Vincent Van Gogh while the rest of the pigments will be faded in the framework of model paint-outs colour changes experiments.

Pigment Lemon chrome yellow L2b : $PbCr_{1-x}S_xO_4$ with x = 0.5

Description Mixed crystals of lead chromate and lead sulfate. Pigment found in the Sunflowers painting of Van Gogh

Recipe Winsor & Newton, recipe originally called *Super Lemon Chrome*
Recipe transcribed and tested during the PhD Thesis of Vanessa Otero (2018)

Date From 08/04/2019 to 12/04/2019

Location Department of Conservation and Restoration, University NOVA of Lisbon, Campus da Caparica, Portugal

Participants Pigment making : Vanessa Otero[1] assisted by Gauthier Patin[2]
Pigment selection : Vanessa Otero, Muriel Geldof[3], Ella Hendriks[4]

Purpose The pigment will be implemented in three different projects:

1. The majority of the pigment will be used by the artist Charlotte Caspers in order to paint a reconstruction of the Sunflowers painting by Van Gogh. This reconstruction has been ordered by the Van Gogh Museum in the frame of the 2019 summer exhibition on the sunflowers.
2. A small part of the pigment will used by Gauthier Patin for his PhD experiments on colour changes in Van Gogh artworks.
3. Another small amount will be given to Laurens van Giersbergen for his Master thesis experiments on the comparison of different light aging devices.

Results Three batches of pigment have been made (cf. Illustration 6):

1. On the 09/04/2019 : 4.4563 g
2. On the 11/04/2019 : 21.0083 g
3. On the 12/04/2019 : 18.7489 g

The total amount of pigment is 44.2135 g. A tiny quantity of each batch has been stored in small plastic container and given to Vanessa for further analysis if needed.
More information about each batch is given below.

Safety Since chromium (VI) oxide is extremely toxic, each step of the recipe has been performed under a fume-hood with blouse, gloves, and glasses. We recommend to read the International Chemical Safety Card on chromium (VI) oxide before making such pigment.

Ingredients

- Water (H_20)
- Potassium dichromate ($K_2Cr_2O_7$)
- Sodium carbonate (Na_2CO_3)
- Barium sulfate ($BaSO_4$)
- Nitric acid (HNO_3)
- Lead (II) oxide (PbO)
- Sulfuric acid (H_2SO_4)
- Sodium sulfate (Na_2SO_4)

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09/04/2019

Lemon Chrome L2b - Batch N°1.

Synthesis

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56 ml of H_2O
+
2.120 g of Na_2SO_4
+
13 ml of boiling H_2O + 1.325 g of $K_2Cr_2O_7$ + 1.113 g of Na_2CO_3 (boil and stir for 30 min ; add water to fill up to 13ml)
+
13 ml of $Pb(NO_3)_2$[#]
+
0.308 ml of H_2SO_4 in 1 ml of H_2O
+
stir for 30 min (cf. Illustration 3)
+
washing the pigment with milliQ water and then with ethanol and finally with ethylic ether (cf. Illustration 4)

[#] 150 ml of boiling H_2O + 32.3 ml of HNO_3 + 53.5 g of PbO (cf. Illustration 1)

Quantity of pigment obtained : 4.4563 g

pH measurements

Ingredients	**pH value**
H_2O + Na_2SO_4	5.33
H_2O + Na_2SO_4 + $K_2Cr_2O_7$ + Na_2CO_3	10.13
Final solution	2.30

11/04/2019

Lemon Chrome L2b - Batch N°2.

Synthesis

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250 ml of H_2O
+
9.41 g of Na_2SO_4
+
60 ml of boiling H_2O + 5.88 g of $K_2Cr_2O_7$ + 4.94 g of Na_2CO_3 (boil and stir for 30 min ; add water to fill up to 60ml)
+
57 ml of $Pb(NO_3)_2$[#]
+
1.7 ml of H_2SO_4 in 2 ml of H_2O
+
stir for 30 min (cf. Illustration 3)
+
washing the pigment with milliQ water and then with ethanol and finally with ethylic ether (cf. Illustration 4)

[#] 150 ml of boiling H_2O + 32.3 ml of HNO_3 + 53.5 g of PbO (cf. Illustration 1)

Quantity of pigment obtained : 21.0083 g

pH measurements

Ingredients	**pH value**
H_2O + Na_2SO_4	6.01
H_2O + Na_2SO_4 + $K_2Cr_2O_7$ + Na_2CO_3	10.30
H_2O + H_2SO_4	2.02
Final solution	2.52

12/04/2019

Lemon Chrome L2b - Batch N°3.

Synthesis

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250 ml of H_2O
+
9.41 g of Na_2SO_4
+
60 ml of boiling H_2O + 5.88 g of $K_2Cr_2O_7$ + 4.94 g of Na_2CO_3 (boil and stir for 30 min ; add water to fill up to 60ml)
+
57 ml of $Pb(NO_3)_2$[#]
+
1.7 ml of H_2SO_4 in 2 ml of H_2O
+
stir for 30 min (cf. Illustration 3)
+
washing the pigment with milliQ water and then with ethanol and finally with ethylic ether (cf. Illustration 4)

[#] 150 ml of boiling H_2O + 32.3 ml of HNO_3 + 53.5 g of PbO (cf. Illustration 1)

Quantity of pigment obtained : 18.7489 g

pH measurements

Ingredients	**pH value**
H_2O + Na_2SO_4	5.90
H_2O + Na_2SO_4 + $K_2Cr_2O_7$ + Na_2CO_3	10.16
Final solution	2.29

Photos

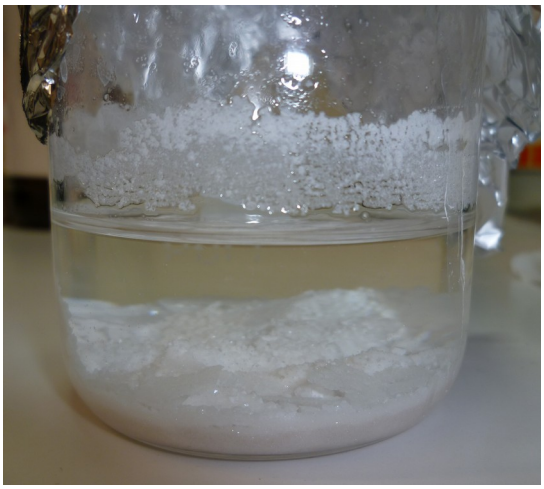

Illustration 1: Lead nitrate solution

Illustration 2: Chromate solution

Illustration 3: Final solution (before filtering and washing)

Illustration 4: Washing of the pigment

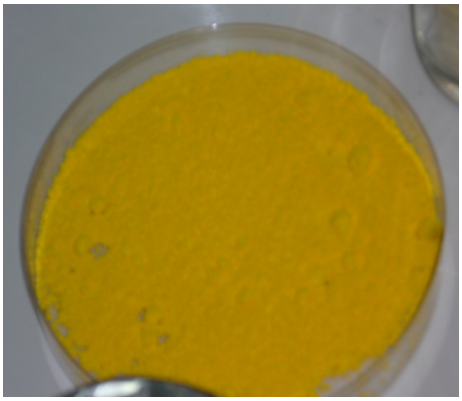

Illustration 5: Pigment drying

Illustration 6: The three batches