Direct carbon printing

Warning

The use of bichromate (toxic) is no longer authorised in France or in Europe, so this text is presented on a "historical" basis.

Goal
To obtain a direct pigment print (without transfer) with halftones and nuances.
This process is similar to Artigues and Fresson, but does not claim to reproduce them.

Principle
With gum bichromate, the pigment is incorporated into the sensitive layer (gum + dichromate + pigment). Here the gelatine replaces the gum, and the sensitive colloid (gelatine + bichromate) and the pigment are applied separately.
The result obtained has good range of nuances, and with some images a satisfactory result can be obtained with this single layer.
To obtain a wider range of tones, a second layer is added, which contributes additional nuances.

Method in detail

Paper
A paper resistant to repeated soaking (watercolour) is required.
A light texture is suitable, but too heavy a texture decreases the definition of the image, which is regrettable, because the process can produce considerably refined detail.
The paper can contain an alkaline buffer (acid-free paper); this makes no difference.
Preparing the paper
Hot soaking improves dimensional stability; it helps the proper superimposition of successive layers.
Sizing and prior tanning are not mandatory, but this makes it possible to obtain clean whites without "parasitic" pigments that cling to the paper.

Gelatine (sweetened) 3%:

Cold water	*100 ml*
Gelatine	*3 g*

Let the gelatine swell (5-15 minutes)
Heat to 40°-50° and stir until completely dissolved
Add 30 ml of sugar syrup to soften the gelatine.

The gelatine is spread with a foam roller or brush; 5 ml will be needed for a 24 x 30 sheet (excluding what is absorbed by the roller). You can also soak the sheet in the warm gelatine solution.
Leave to dry; soak in a tanning solution, then dry again.
Formalin is the ideal tanning solution (30 ml/L) but this must be done outside because the vapours are toxic. You can also use alum or Glyoxal.
These steps can be done in full light.
It is possible to size in advance because paper prepared in this way keeps indefinitely.
Some photographers use acrylic sizing (gesso). This is simpler; I personally don't like the effect obtained, but it works.
Sensitive layer
The same 3% gelatine preparation is used with added sugar.
Erick Mengual freezes his gelatine in ice cube trays, and when he wants to prepare his paper, he takes out a frozen cube of gelatine and lets it melt at room temperature.

If you prefer to prepare your gelatine as you go along, you have to work with small amounts because solidified gelatine kept at room temperature and then remelted works poorly.

Sensitive layer for 4 to 5 24 x30 cm *sheets*

Gelatine	*13 ml*
Bichromate 10%	*13 ml*

Bichromate 10% (keeps well):

Water	*100 ml*
Bichromate	*10 g*

The concentration of potassium dichromate can be reduced by up to 5%. This changes the sensitivity and contrast, and you just need to adapt the exposure and contrast of the negative accordingly.

Extending the sensitive layer

On the prepared paper, well-dried, you apply the layer of bichromate gelatine, working in a dim light. The spreading is done with a foam roller or brush. The layer should be even, but it does not need to be perfect.

Once covered, the sheet is left to dry in in the dark.

The coated sheet should be used within 24 to 48 hours max. (2 to 5 hours is ideal) because it loses its sensitivity.

Pigment layer

It is possible to work with powdered pigments, but watercolour in a tube gives more finesse and nuances, and a more finely detailed[1] image. Make the effort to try out the watercolour before using powdered pigments; this will give you an idea of what the process produces.

This guide describes how to produce a black and white image, but pigments of all shades can be used.

You can also create images in multi-layered colours (CMYK or other combinations).

Ivory black is warm; fresco black is more neutral. Using different pigments for the two layers (main gelatine and complementary gum) is interesting, as it gives "depth" to the image. I often use fresco black as a main pigment and ivory black for highlights.

Pigment layer for 1 or 2 24 x 30 sheets:

Watercolour in tube	*1 to 2 g*
30% gum	*5 to 10 g*

Mix until the solution is even.

30% gum:

Water	*100 ml*
Gum	*30 g*

Place the gum blocks in a gauze (or stocking) suspended in the water, where the gum will slowly melt. Leave to infuse 12 to 24 hours. When almost all the gum is dissolved, take out the gauze and wring it out to recover the rest of the gum.

Stir the gum solution to homogenise it and add a little preservative (thymol, formalin, phenol or Sennelier preservative).

The amount of gum to be added to the watercolour varies according to the type of pigment used and the intensity of the black you want to obtain.

Spreading the pigment layer

The layer (about 6 g for a 24 x 30 sheet) is applied with a roller or foam brush. You need to obtain an even layer, without traces of spreading. A final very light brush with a dry splatter (wide flat brush) will eliminate any traces of spreading.

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[1] Tube watercolour is made of pigments, gum and additives that improve preservation and give flexibility to the mixture. Powdered pigments can give the same finesse as tube watercolour: here the powder must be very finely ground.

Superior quality watercolours (Sennelier, Winsor & Newton, etc.) give a much finer image than low-end watercolours, because the pigments are more finely ground.

Leave to dry in the dark.

Exposure

Negatives adapted to gum are well suited to this process.
underexposure requires UV light, and the exposure time is longer than with gum (about 2 to 4 times longer). A few tests will make it possible to find the correct time
As the process does not have the flexibility of gum, the more precise the exposure, the better the tonal range – so tests are useful.
When the layers are prepared consistently, there is a good level of repeatability once the process has been fine-tuned. Tests are only needed if a negative deviates from the usual production.

Developing

I start with a cold water bath (15°-20°) for 2-3 minutes.
Then I soak the leaf in warm water (30°-40°) for 2-3 minutes.
Finally I develop it with a spray: a very light jet of water, little more than a mist.
You can repeat the cycles of warm water and spray as often as needed.
It is also possible to soak the print, image down, long enough (one hour or more) for the image to develop by itself.
A final bath of cold or warm water for 2-3 minutes, image down, eliminates any pigments remaining in the whites.
From this description, everyone will find the method that suits them best, including action with the brush (light) to "scrape" the image, or Developing with a mixture of water and fine sawdust.

Water containing dichromate must be neutralised with sodium sulphite or EDTA to destroy the hexavalent chromium.

Image hardening

An alum bath (3-5 minutes) tans the image, making it more robust for subsequent treatments.

Hot water	*1000 ml*
Potassium alum	*30 g*

After tanning it, wash the image with water (5-10 minutes) and then dry it in the open air.
Erick Mengual does not use alum, but after washing he dries the image with a hair dryer, which has a tanning effect.

With a precise exposure, a suitable negative and an image that does not require too much detail in terms of light and shadow, we can stop there, but in the majority of cases a second layer will bring out details in the light and shadow.

Second layer

This layer is a classic gum bichromate, but with a very diluted pigment. This will bring out details in the highlights, in particular.

Second layer for a 24 x 30 sheet

Pigment (watercolour tube diluted with water 1+3)	*1 drop*
30% gum	*2.5 ml*
12% bichromate	*2.5 ml*

Use the standard spreading method, and dry in the dark.

Exposure of the second layer

The negative is superimposed, and the print is exposed to light for double the "normal" exposure time.

Development

Similar to the first layer.

Water containing dichromate must be neutralised with sodium sulphite or EDTA to destroy the hexavalent chromium.

Final treatment

After a brief wash, a metabisulphite bath at room temperature (3-5 minutes) removes the final dichromate residues.

Hot water	1000 ml
Potassium metabisulphite	10 g

If necessary, you can also tan the image in an alum bath (see above)
Careful washing ensures perfect preservation.
The image should dry in the open air: the paper is hung, placed on a rack or stretched using kraft paper on a rigid support to obtain perfect flatness.

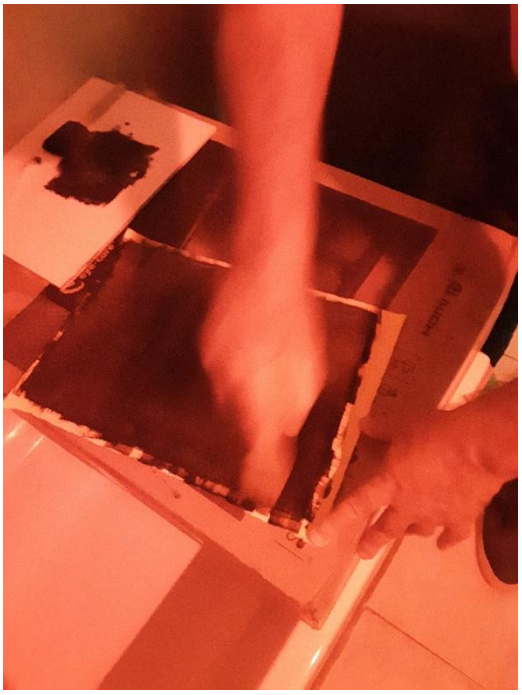
Remarks

Prior sizing is not always necessary: some papers deliver clean whites without any treatment.
Intermediate tanning (after the first layer) facilitates the stripping of the second layer.
Detail in the image is linked with the size of the pigment grains, as follows (from the finest to the coarsest):

1. Superior watercolour,
   powdered pigment crushed (for a long time!) with a glass pestle on frosted glass
2. Ordinary watercolour,
   High quality powdered pigments (Sennelier),
   powdered pigments ground with coffee grinder
3. Ordinary powdered pigments

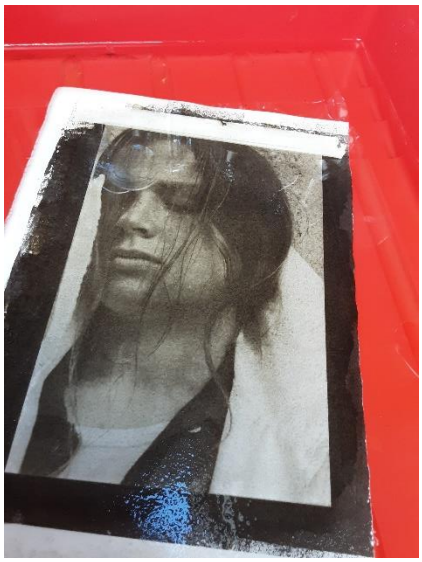
Pascal Miele August 2021

Gelatine preparation

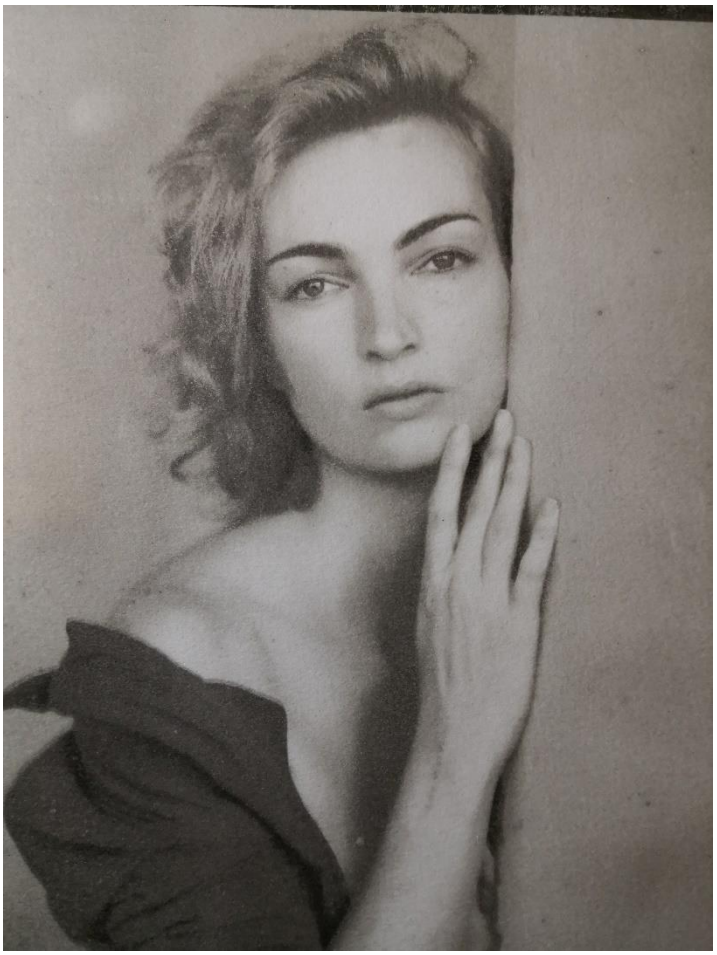


Pigment layer

First layer (gelatine)



Second layer (gum)



Ambre