Chemical Materials as Heritage: The Hafkenscheid Collection (ca. 1825) at Haarlem

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Cet article, en anglais, retrace l'étude de la collection Hafkenscheid, une collection de pigments datant du début du 19^e^ siècle.

This article demonstrates that the Hafkenscheid Collection is unique and very broad (370 samples), dating back to the years ca. 1800 – ca. 1835, and that the study of the collection has a great relevance for fields as different as art history, history of chemical technology, and business history.

Starting in Great Britain during the 1960s, the study of industrial heritage has increasingly been practised in many European countries. Special journals have been launched, including in 1976 the French journal *L'Archéologie industrielle en France*, renamed *Patrimoine industriel* in 2014. In the literature on industrial heritage, the attention paid to chemical heritage is almost neglectable. Among the numerous books published since 1970, only R. Angus Buchanan's *Industrial Archaeology in Britain* (1972) devoted a separate chapter to the chemical industries.

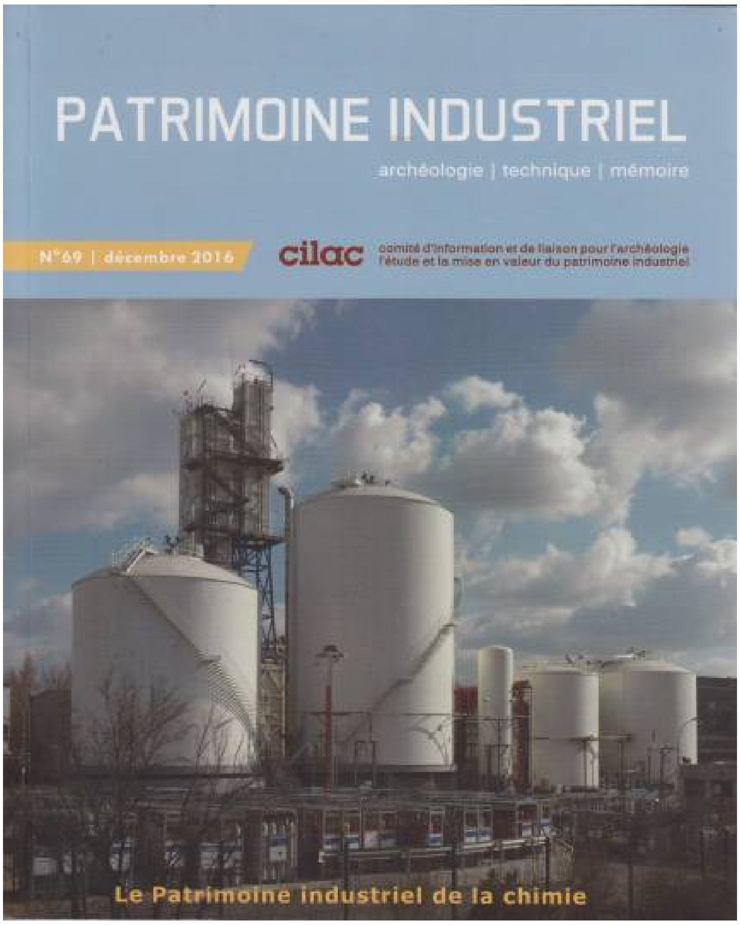

Figure 1 - Le patrimoine industriel de la chimie
The special issue of the journal *Patrimoine industriel* on the chemical industry in France is a masterpiece on chemical industrial heritage.

Auteur(s)/Autrice(s) : L. Kruszyk, Région Île-de France / CILAC

Another early pioneer was W. Alec Campbell, who in his book *The Chemical Industry* (1971), paid attention to old chemical sites and to chemical investigations of polluted soils and waste heaps of the British alkali industry. [1]

There is one great exception though, which is the special issue *Le patrimoine industriel de la chimie*. [2] With almost twenty chapters on French chemical industries and sites, and more than five chapters on archives and collections, this book is unique in its kind. But even in that book there is not much attention paid to old collections of chemical substances. Those collections are dispersed over many different museums, and were seldom the subject of study. Therefore the investigation of the so-called 'Hafkenscheid Collection' of painting materials, presented in this paper, merits special attention. [3]

1. The Collection

The Hafkenscheid Collection includes more than 370 samples or materials of various kinds, such as pigments, gums, resins, adhesives, mordants, metal ores, chemicals and natural dyes, mainly used by artists and house painters, but also in dyeing and in other urban trades. The collection was created by the Amsterdam druggist and wholesaler of painting materials Michael Hafkenscheid (1772-1846) during the first decades of the nineteenth century. It probably served as a reference collection for his trading activities, but perhaps also to educate his eldest son and successor Antonius Hafkenscheid (1804-1877).

Figure 2 - The Hafkenscheid family
The Hafkenscheid family painted in 1829. Michael Hafkenscheid is the 4th person from the right, and his son Antonius is the 2nd person from the left.

Auteur(s)/Autrice(s) : Petra Appelhof, Nijmegen

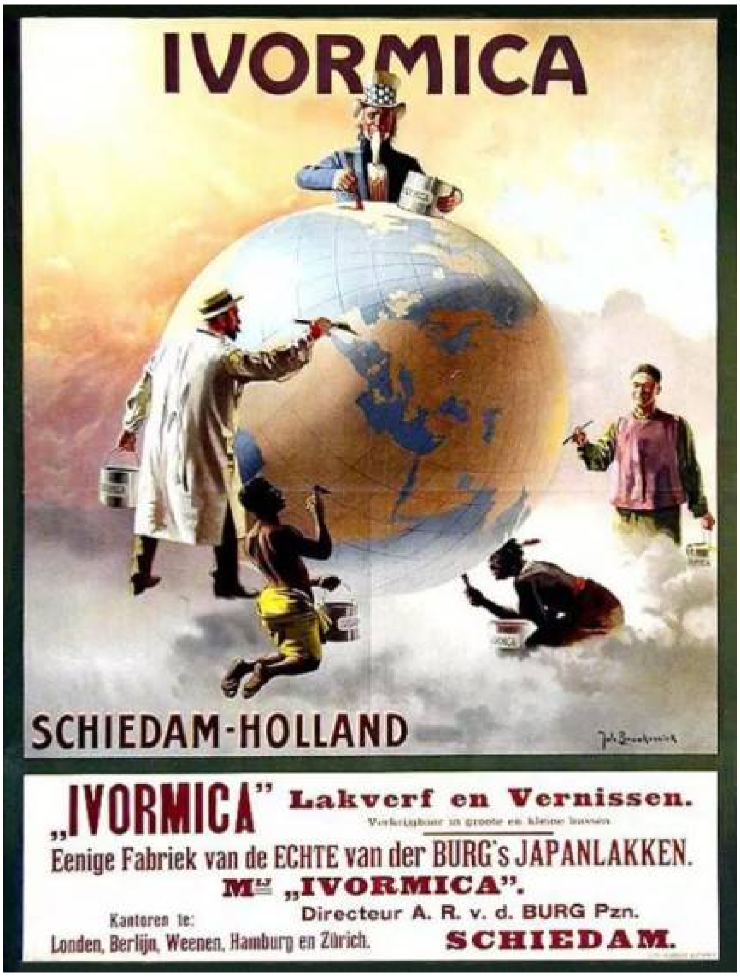

Figure 3 - Ivormica
At the end of 1927 the Hafkenscheid firm was sold to Ivormica, a producer of coatings and varnishes at Schiedam, near Rotterdam. The picture shows an advertisement poster from 1909.

Auteur(s)/Autrice(s) : Johan Braakensiek Licence : Domaine public

The collection was stored in a wooden cabinet, kept near at hand by the trading firm of M. Hafkenscheid & Zoon. When that firm was sold to the Ivormica company by the end of 1927, the cabinet and collection were sold to the Department of Inorganic Chemistry of Delft University of Technology. Some samples from the collection were used in pioneering scientific investigations of old paintings by the chemist and restorer Martin de Wild (1899-1969), who was one of the first in the Netherlands to initiate scientific research on paintings [4].

2. Bringing the collection to life

For many decades the collection had almost been forgotten. It was stored in the basement of the chemical laboratory at Delft, was rarely used in research, and never investigated as such. This changed in 1983 when the chemical analyst and student of art history Ineke Pey, on the advice of a colleague from Leiden University, decided to investigate the collection in depth and write her Master Thesis on that topic.

Figure 4 - The Hafkenscheid cabinet
The mahogany wooden Hafkenscheid cabinet from about 1800. The first 15 drawers contain the Hafkenscheid collection of chemical materials, dating ca. 1800-1825. The lower drawers mostly contain objects from a later date.

Auteur(s)/Autrice(s) : Martijn Zegel, Teylers Museum, Haarlem

During the following year she described the entire collection in detail, and employed a whole array of laboratory techniques in order to determine and verify the (chemical) composition of about 190 different mainly inorganic samples. Non-investigated samples were often other examples of the same product, or samples of dry and unprepared plant materials. On a list (inventory), probably dating back to the 1830s, the content of the entire collection had been written down by hand. All 190 samples were investigated with different techniques such as ordinary (light) or polarised-light microscopes, and with so-called 'wet chemical microanalysis'.**[1]** In most cases, these two methods already gave sufficient information to identify and characterise a sample. When more detailed information was required, more advanced instrumental techniques were used: infrared spectroscopy, laser micro-spectrum analysis, X-ray diffraction, scanning electron microscopy, high-pressure liquid chromatography (for prepared organic dyes), electron microprobe E.D.S. (energy dispersive spectroscopy, for dyes on substrates), flame-emission photometry, and, finally, atomic absorption spectroscopy. For experiments with more advanced equipment, great help was received from the art research laboratories of the Dutch and Belgian cultural heritage organisations, respectively in Amsterdam and Brussels**[2]**.

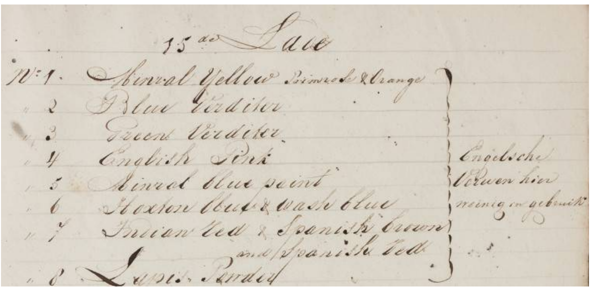
15de Laa
No 1 Mineral Yellow Primrose & Orange
2 Blue Verditer
3 Green Verditer
4 English Pink
5 Mineral blue paint
6 Saxon blue & wash blue
7 Indian red & Spanish brown and Spanish red
Engelsche Waren hier weinig in gebruik

Figure 5 - Detail of the inventory list of the 15th drawer

Detail of the inventory list of the 15th drawer, listing several pigments imported from England. Hafkenscheid wrote in the margin that they were not much in use.

Auteur(s)/Autrice(s) : Ineke Pey, Den Velde

As indicated above, determination of chemical composition was in most cases performed by ‘wet chemical microanalysis’[3], with the help of spot-tests[4], in combination – if necessary – with (polarised-light) microscopy. These methods were chosen because we wanted to analyse only very small samples, in order to disturb the collection as little as possible. The chemical spot tests were performed under a stereo microscope, or dissecting microscope, which is an optical microscope designed for low magnification observation of a sample (in this case 80x), typically using light reflected from the surface of an object rather than transmitted through it. The chemical tests were done on small flat microscope slides[5].

To make this more concrete for the reader, we will focus on the investigation of a red-orange pigment from the collection. On the hand-written inventory-list of the collection that sample was called true “orange minraal” from Paris. The name orange mineral refers to a purer kind of red lead, which is a lead oxide. Despite that indication on the inventory-list, chemical investigation was crucial for several reasons:

- to check whether the order of materials inside the cabinet still corresponded with the list after 150 years;
- to check whether the pigment indicated was perhaps mixed with other substances;
- to check whether the composition of pigments from the trade practices corresponded with the theoretical composition mentioned in handbooks.

In theory, if the order of the materials in the cabinet and the order on the list did not correspond (anymore), several other red and orange pigments on the list could be candidates for the sample investigated: iron oxides, such as red ochre (Fe_2O_3), red lead (Pb_3O_4), vermillion (HgS), realgar (As_2S_2), and organic lakes, such as madder lakes (madder dye on alumina).

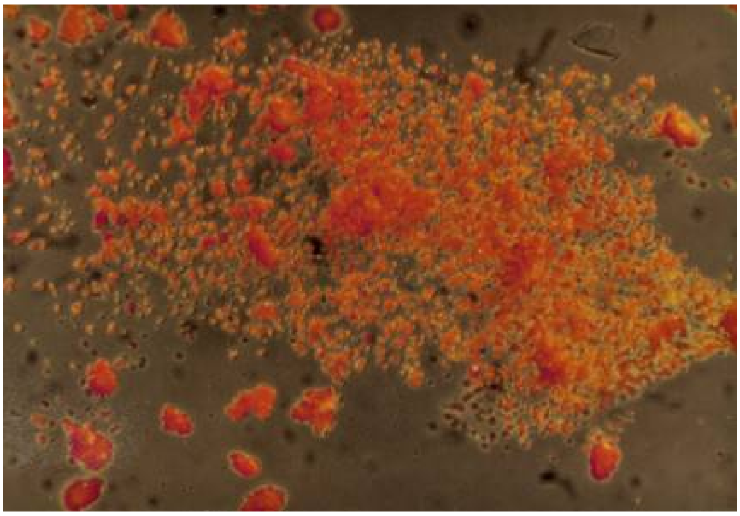

Figure 6 - Crystals of “orange minraal”

A picture through the microscope of the crystals of an ‘orange mineral’ (Pb_3O_4) from Paris (magnification 200x).

Auteur(s)/Autrice(s) : Ineke Pey, Den Velde

The sample was first investigated under a microscope, with a magnification of 200x, with incident and transmitted light. This showed us small bright orange crystals in many different shapes, which were mostly clear and transparent. Some of the orange crystals were opaque. In transmitted light there were dark particles with a grainy surface, with very few white and metallic black crystals in between the far greater number of orange ones. These observations made it already improbable that the sample was a usually very fine powdered madder lake.

After this visual inspection, the sample was investigated with chemical tests. Drops of test liquid, such as acids and bases, were added while the reaction was viewed under a stereo microscope. HCl, of a strength of 3 mole/ litre, decolorized the sample in the cold a bit slowly, but quickly after heating, leaving a white residue, and a few brown crystals. There was no emission of the ugly smelling H_2S, which made the presence of vermillion and realgar very improbable. Of the pigments mentioned, only red lead (Pb_3O_4) dissolves in the HCl aqueous solution mentioned above, leading to a characteristic white precipitate of $PbCl_2$ behind**[6]**. An aqueous solution of 4 mole/litre NaOH did not dissolve the sample, but in the heat the sample decomposed. Madder lakes do dissolve in NaOH aqueous solutions, so the presence of those lakes was definitely ruled out by that test.

Figure 7 - Samples of red lead in the 9th drawer

Two samples of red lead in drawer 9 of the cabinet. To the left is a sample of ordinary minium; to the right, the sample of 'orange mineral' from Paris. The investigation of that sample is described here, and the microscopic picture of some crystals is shown.

Auteur(s)/Autrice(s) : Martijn Zegel, Teylers Museum, Haarlem

In order to check whether the pigment was indeed red lead, specific tests on Pb were done. Tests on Pb (II) with KI in HCl were positive, giving a characteristic precipitate of yellow PbI_2**[7]**. Also with K_2CrO_4 – in the presence of HCl – the test was positive, because a yellow precipitate of $PbCrO_4$ resulted**[8]**. In acetic acid the sample dissolved**[9]**. In concentrated HNO_3 the sample turned brown, which confirmed the formation of more lead dioxide (PbO_2)**[10]**. The reaction product was dried, then dissolved in acetic acid. It showed a brown colour that was typical of the triple nitrite reaction, which confirms the presence of a double salt of three elements (in this case: $PbNO_2$, $PbNO_2$, and $Pb(NO_2)_2$). On the basis of these results we could conclude that the sample was indeed red lead or minium (Pb_3O_4), and that (a) the correspondence with the inventory-list was perfect; (b) the pigment was rather pure, and only mixed with small traces of dark contaminants (PbO_2); and (c) the composition $PbO_2.2PbO$ of the red lead confirmed what was theoretically expected.

The results of these extensive experiments were documented in 1985 in a Master Thesis written by Ineke Pey. In that thesis, research in (old) books on the history of pigments and their nomenclature was reported, in which the other author of this paper, Ernst Homburg, was also involved. [6] In the following years, Ineke Pey published several articles on the Hafkenscheid collection, which made this unique set of painting materials quite well-known among art historians, restorers, and scientists involved in research on paintings. [7]

Through these publications the collection 'came to life' again. In 1995 Delft Technical University donated the collection to Teylers Museum at Haarlem, which was a far more appropriate location for these materials. An exhibition devoted to the collection was held in 1995. Since then, some other researchers investigated samples from the collection. In our view, Teylers Museum should take utmost care to make sure no unique sample from the collection disappears or gets contaminated, considering that a few examples that were still there in 1984 are now missing.

3. Dating the collection

Michael Hafkenscheid had been employed by the trading firm Tollens, Usellino & Comp. in Amsterdam since 1806, or perhaps even earlier. He later became a partner, and from around 1820, he continued the firm under his own name. In 1826, he was joined by his son, who also became a partner in the firm. The name was then changed to M. Hafkenscheid & Zoon.

Tollens, Usellino & Comp. was part of a network of firms owned by members of the Tollens family, located in Ghent, Rotterdam and Amsterdam. It included trading firms, shops with painting materials and small workshops for the manufacture of brushes or pigments.[11]

Figure 8 - The Binnenkant canal
From the late 18th century onwards the Hafkenscheid company was located in the centre of Amsterdam, close to Dam square. In 1885 the firm moved to buildings located at the east of the centre, in order to have a better access to transport of its chemical materials by ships.

Auteur(s)/Autrice(s) : Stadsarchief Amsterdam (Municipal archives, Amsterdam)

As a result of the long history of the firm, it is understandable that there are also some samples from before 1806 in the collection. On the basis of written dates found on paper wrappers around some samples, as well as on the inventory from the 1830s, it appears that the oldest samples found in the collection were a green pigment from berries (eighteenth century), amber (1802), Dutch pink (1803), Naples yellow (1804) and *caput mortuum* (iron ochres) (1804). The newest samples mentioned in these written sources were rottenstone (1831) and turmeric (1832).[12]

There are also a few novel pigments in the collection, that had just been invented, such as chromate yellow (1815). But many other new pigments invented in the first half of the nineteenth century were missing. This confirms our conclusion that the collection was created between ca. 1800 and ca. 1835, without additions from a later date. This makes the collection a very interesting and rather unique example of material chemical heritage from the earliest decades of the nineteenth century. Because of its unique character the collection can be important for investigators working in different areas, such as art history, history of chemical technologies, and business history.

4. Relevance for the history of art

For about a century, chemical and other scientific investigations of paintings have played an ever-growing role in the history of art, and in the restoration of paintings in particular. [8] These investigations are essential to know more about earlier restorations of old paintings. What painting materials were originally employed? What pigments or varnishes were added later? What variety of a certain pigment is needed to restore a painting in the most adequate way? Questions such as these can only be answered by employing the most advanced scientific techniques possible.

Figure 9 - The 8th drawer
The Hafkenscheid cabinet contains many materials that are very important for art historians. Drawer 8, for instance, houses a large collection of old gums and resins, such as shellac, copal gum, gum Arabic, and asphaltum.

Auteur(s)/Autrice(s) : Martijn Zegel, Teylers Museum, Haarlem

But using these methods of analytical chemistry is not sufficient. With these techniques one can measure, for instance, the percentages of lead, copper, sulfur, or carbonates that a certain sample from a painting contains, and propose a chemical formula; but in order to give a correct interpretation in terms of the pigments used by the artist, knowledge of ancient artists materials is also needed. [9] In theory, one could study handbooks for painters from the seventeenth to the nineteenth century to discover the names of the materials used, but that knowledge will not solve all the puzzles. Indeed, in the course of time, the composition of materials has changed, even if the name stayed the same, due to the replacement of natural materials by synthetic ones, or because of the evolution of manufacturing techniques, or due to the shift from one mine to another, etc. So for instance, white lead made in the seventeenth century differs from white lead manufactured today. [10]

Seen in that light, the Hafkenscheid Collection dating from the years 1800-1835 – just before the great industrial revolution in pigment production – still contains many painting materials that were also used during the seventeenth and eighteenth centuries. Therefore, it can be of great relevance as a reference collection for the investigation and restoration of old paintings. Indeed, for those tasks, good collaboration within the ‘triangle’ of (1) art history, (2) laboratory investigations, and (3) knowledge of historical reference collections is crucial.

5. Relevance for the history of chemical technologies

Figure 10 - The windmill ‘De Zoeker’

Pigments and other painting materials were imported into the Netherlands from all over the world. Since the 16th century the region ten miles north of Amsterdam was highly industrialised with hundreds of windmills in which also pigments were ground to high quality powders. During the 19th century several of these mills also introduced steam engines. The steam paint factory De Zoeker was one of those.

Auteur(s)/Autrice(s) : Gemeentearchief Zaanstad (Municipal archives Zaanstad)

As noted in the previous section, the chemical composition of painting materials has changed over time, even when the trade names of the products stayed the same. Although books on early chemical industries and technologies do exist, the description of production processes in those books is often rather general. [11]

They are mostly based on books from the seventeenth to the nineteenth century that do not disclose many trade secrets that were employed in practice and therefore do not give reliable information on the composition of the product. [12]

Chemical analysis of samples from former centuries is therefore a valuable addition to our knowledge of the production processes taking place in pre-modern chemical industries. For instance, the impurities detected in the samples give information on the raw materials used, and on the actual production processes that were carried out.

The chemical analysis of samples can also prove that two products with the same trade name might have a totally different chemical composition. The Dutch name ‘berggroen’ (mineral green; green verditer; green bice) can serve as an example. After our chemical analysis it appeared that the mineral malachite, as well as synthetic basic copper carbonates, and green chemicals with another composition were all traded under the name ‘berggroen’. The same is the case for products named ‘bergblauw’ (mineral blue), with could refer to both natural azurite and the synthetic Prussian blues, invented during the early eighteenth century. In order to clarify puzzles such as these, chemical analysis of samples from historical collections, such as the Hafkenscheid Collection, is crucial.[13]

6. Relevance for business history

The fact that the material samples in the Hafkenscheid Collection were accompanied by an inventory dating back to the early nineteenth century, on which some manufacturers were mentioned, and that in some cases samples were also packed in wrappers with names of suppliers, was a very lucky circumstance. Raw materials, for instance, came from Liège, Germany, Cologne, Kassel, Salzburg, France, England, Bristol, Spain, Malaga, Sweden, St. Petersburg, Italy, Venice, Verona, the Levant, Smyrna, Aleppo, Turkey, Bengal, the East-Indies, China, Brazil, America, and many more places, which gives us information on the very wide trade-network of the port of Amsterdam that was utilized by Michael Hafkenscheid.[14]

Figure 11 - A detail of the 2nd drawer
Many names in the collection are highly interesting, and give a clue about where certain materials came from. There are many ochres in the collection, including yellow ochres (above) from France and Germany, and red ochres (below) from Sweden and China.

Auteur(s)/Autrice(s) : Martijn Zegel, Teylers Museum, Haarlem

In some cases, specific manufacturers were also mentioned. Examples are white leads from a factory in Hull, from Kremnitz in Austria, and from Dutch factories in Bodegraven, Schiedam, Rotterdam and Wormerveer; or Frisian greens from Loensma in Buiksloot and Suringar & Nauta in Leeuwarden; or Bremer green from Hafkenscheid's own factory. Examples such as these give us an insight into the specific trade relations of the company. They supplement information on industry from published and archival sources, and, finally, in combination with chemical analysis, they can provide information on differences in the quality of the products on the market. Finally, the ambiguities in the nomenclature of trade products can supply information about the different markets for painting materials. The fact, for instance, that Prussian blue was traded as 'mineral blue', the traditional name of azurite, is an indication that when Prussian blue was invented, and not yet very known, it was put on the market in competition with the traditional natural product. Only later, in the nineteenth century, when it was more established and when chemical analysis had improved, was it more often traded under its specific name. [13]

Figure 12 - Een Kabinet vol kleur
More details on the collection can be found in the book *Een kabinet vol kleur*, published 2018.

Auteur(s)/Autrice(s) : Martijn Zegel, Piet Gerards / Vantilt Publishers

7. Conclusion

We hope to have demonstrated that the Hafkenscheid Collection is unique and very broad (370 samples), dating back to the years ca. 1800 – ca. 1835, and that the study of the collection has a great relevance for fields as different as art history, history of chemical technology, and business history.

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La Clé des Langues

NOTES

1 Microanalysis is the chemical identification and quantitative analysis of very small amounts of chemical substances (generally less than 10 mg). (Wikipedia). In practice, we used circa 5 small crystals for each test, which was well below the indicated threshold of 10 mg.

2 Pey and Homburg, *Een kabinet vol kleur*, pp. 63-65, 274-279.

3 Wet chemical analysis is chemical analysis in, usually aqueous, solution. In this aqueous solution containing the reagents (see the example below), we added the crystals, so that the identification reaction took place in solution.

4 A spot test is a simple and efficient technique where analytical assays are executed in only one, or a few drops, of a chemical solution, without using any sophisticated instrumentation. (Wikipedia)

5 We give here only a brief example, as an illustration, and do not intend to present a practical manual. For details of the method, see reference 5.

6 $Pb_3O_4 + 4 HCl = 2 PbCl_2$ (white precipitate) + PbO_2 (brownish) + $2 H_2O$. The equations mentioned here and below are tentative, because in the reactions between the crystals and drops of reagents the different reactants are not added in stoichiometric proportions. It is the characteristic colour of a resulting product that is crucial in these cases.

7 $Pb_3O_4 + 4 HI = 2 PbI_2$ (yellow precipitate) + PbO_2 (brownish) + $2 H_2O$.

8 $Pb_3O_4 + 2 K_2CrO_4 + 4 HCl = 2 PbCrO_4$ (yellow precipitate) + PbO_2 (brownish) + $4 KCl + 2 H_2O$.

9 $Pb_3O_4 + 8 HAc = 2 PbAc_2 + Pb(OAc)_4 + 4H_2$ (both in solution).

10 $Pb_3O_4 + 2 HNO_3 = 3 PbO_2$ (brown precipitate) + $2 HNO_2$.

11 Pey and Homburg, *Een kabinet vol kleur*, pp. 25-33.

12 Pey and Homburg, *Een kabinet vol kleur*, pp. 63-65.

13 Pey and Homburg, *Een kabinet vol kleur*, pp. 197-199, 206.

14 Pey and Homburg, *Een kabinet vol kleur*, pp. 258-273.