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TEXTILES

Early-16th-century mix-media retables: Study and conservation of the silk flowers in the Enclosed Gardens of Mechelen

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Abstract
The Mechelen Enclosed Gardens are extraordinary early-16th-century religious ensembles made from numerous materials and techniques, including silk flowers, polychrome statuettes, metal pilgrim badges, wax medallions, relics and objects crafted from alabaster, parchment, paper and pipe clay. Finishing decorative touches include spangles, pearls and beads made of glass, bone, coral and amber. Painted panels form shutters that reveal or conceal the treasures within. This paper describes a study of the Mechelen 'Paradise Gardens' and a project (2014–19) aimed at their conservation, with a focus on the content of the oak wooden cases and the unique silk artificial flowers.

INTRODUCTION

The Mechelen Enclosed Gardens are exceptional Christian mixed-media representations of an idealised spiritual and paradisiacal world. In addition to an abundance of silk flowers, they include polychrome statuettes, metal pilgrim badges, wax medallions, relics and objects crafted from alabaster, parchment, paper and pipe clay. Finishing decorative touches include spangles, pearls and beads made of glass, bone, coral and amber. The painted panels of the work form shutters that reveal or conceal the treasures within (Figure 1). The Gardens were used in the 16th century for personal rituals of devotional practice by nuns. A striking feature of each of the Gardens is the abundance of vegetation reproduced in wire, silk, parchment and occasionally beads, sequins or freshwater pearls. Alongside the sculptures of Christ, the Virgin and saints, silk artificial vegetation dominates the entire cabinet. Seven Mechelen Enclosed Gardens were hidden in the monastery of the Augustinians until the late 20th century, dust-covered and largely unknown, although art historians had become aware of their existence and artistic value somewhat earlier (Poupeye 1912, Watteeuw and Iterbeke 2018). This paper addresses the study and conservation (2014–19) of the Mechelen 'Paradise Gardens', with a focus on the content of the oak wooden cases and the unique silk artificial flowers.

Figure 1. *Enclosed Garden of Daniel in the Lions' Den,* ca. 1530, Mechelen, Museum Hof van Busleyden, Inv. GHZ BH 004, dimensions 88 × 142 × 23.5 cm

THE ENCLOSED GARDEN PROJECT (2014–19)

In 2014, 20 years after the seven Gardens were moved to the city museum of Mechelen (Hof van Busleyden), a conservation project was established that lasted until 2019. The extraordinary 16th-century religious ensembles, with their array of artefacts, their complex composition and their employment of numerous materials and techniques, demanded a multidisciplinary approach to conservation. Given the rather small surfaces of the various objects, the collaboration of all disciplines was essential, which in turn required an integrated conservation methodology. In the first step, challenges related to both the research aspect and the logistics side of the project were assessed and different task forces were created to draw up a plan. Tests and benchmarks for conservation were set, and methods of treatment were evaluated in detail before they were implemented. In consultation with art historians at the Katholieke Universiteit Leuven (KU Leuven) and the Royal Institute for Cultural Heritage (KIK-IRPA) and the keepers of the Enclosed Gardens in Mechelen, the greatest possible care was taken to preserve the historic stratification. Dust and impurities had to be removed to allow long-term conservation, enhance the 'legibility' and guarantee the long-term preservation of these unique works.

PREVIOUS RESTORATION OF THE ENCLOSED GARDENS (16TH–20TH CENTURY)

Due to the remote location in which the Enclosed Gardens had been kept, no professional conservation treatment had ever been performed until recently, although hands-on repairs had been done in the monasteries throughout the centuries. Handling, natural ageing (patina) and soiling had clearly left their mark over a period of 500 years, and in some cases the damage was irreparable. Organic materials, such as silk, were on the verge of crumbling into dust or falling apart; inorganic elements, including metal supporting structures, had become distorted and/or corroded and numerous artefacts had broken loose from their attachments. Moreover, the Gardens had undergone maintenance from the beginning of the 16th century, and over the years the nuns had regularly engaged in 'refurbishments'. Consequently, not a single one of the Gardens remains in its original state, as all of them, to a greater or lesser extent, have undergone some form of intervention and alteration. Signs of this in-house care include modern metal staples, nylon threads and contact glue to adhere detached pieces. Nonetheless, although signs of maintenance are evident in each cabinet, overall the Gardens have been preserved as fully-fledged entities.

SILK ARTIFICIAL FLOWERS, PRODUCED IN MECHELEN AROUND 1530

The plants and flowers in the Gardens were made using a variety of textile wrapping techniques, mainly the wrapping of floss silk thread and metal thread around cores of brass wire and/or parchment. The dominant colours of the plants are a variety of shades of green, red, orange, pink, yellow, white and occasionally bright blue or purple, as every single leaf, pistil and stem was produced separately before being assembled into a plant. For some of the larger plants, over a hundred single parts had to be made before the final plant could be assembled. Flowers were built up starting with their pistils, after which the petals were added one by one. When the flower was complete, all of the wires were wrapped to form a stem, with the previously made leaves added to the stem as the wrapping proceeded (Figures 2, 3).

EXPERIMENTAL

To fully understand both the composition and the degradation of the silk flowers, detailed photography, scientific imaging and material-technical analyses were performed.

Figure 2. Detail of the *Enclosed Garden* with the peat bottom and several types and bunches of flowers composed of parchment, metal wire and silk

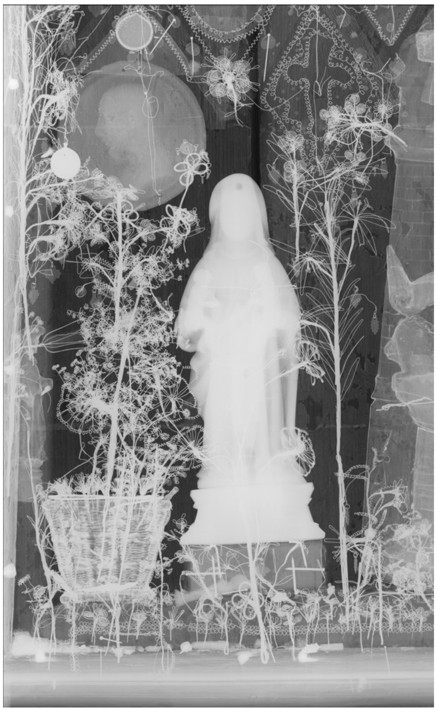

Figure 3. X-ray photography of the same detail reveals the metal wire structure inside the silk flowers

INSTRUMENTATION

Photography and imaging

Documentation consisted of high-resolution photographs of both the whole ensemble as well as particular areas and fields within each of the Enclosed Gardens. Illumination was provided by employing targeted lighting, soft lighting and UV fluorescence. Technical imaging comprised X-ray images of the cabinets by the Scientific Imaging Department of KIK-IRPA, Brussels.

Material technical investigation

To better understand the material basis of the silk flowers and plant artefacts, a set of analyses using non- and micro-invasive techniques was performed at the textile laboratory of KIK-IRPA. The fibre type was identified and the morphological features of the textile fibres and metal threads, including their potential alterations, were investigated using microscopic techniques: digital microscopy (KH 8700, Hirox), optical microscopy with transmitted light (Axioplan, Zeiss) and scanning electron microscopy (SEM, Jeol). Element analysis of the metals was conducted using an energy-dispersive X-ray detection system (SEM–EDX, Jeol, Oxford Instruments) on a small metal thread sample.[1] Micro-invasive identification of the organic dyes and dye degradation was achieved with high-performance liquid chromatography coupled to a photo-diode array detector (HPLC–DAD) (Alliance, Waters) according to a methodology developed in an earlier study (Vanden Berghe et al. 2009).

DISCUSSION

Silk used for wrapping to create petals or flowers

Samples of the silk flowers in the *Enclosed Garden of Daniel and the Lion's Den* were analysed. The silk yarns used to produce the flowers are of an extremely fine quality and made of degummed cultivated silk (*Bombyx mori* L.) multi-filaments with a smooth surface structure and an average thickness of 12 ± 3 µm (Figure 4).

Some of the silk was used undyed, left in its natural colour, such as that used for the large white lilies (*Lilium candidum*); in other cases, the silk was dyed in a wide variety of colours and shades. However, light exposure has clearly damaged the colours considerably. Most of the flowers have faded, with some exceptions in which the bright and brilliant colours have kept their fresh tones. To get a better sense of the original appearance of the artefacts in the garden, the biological dyestuffs present in several red shaded silk yarns were identified.[2] A systematic study of all such artefacts could not be done, as dye investigation was restricted to those samples with loose yarns that could easily be removed. However, dye identification, summarised in Table 1, provided insights into the variety of dyes used and their light fastness over time.

Figure 4. Silk pompon flowers in two different shades of pink (samples 2 and 3)

Table 1. Dye composition and biological dye sources in selected silk flowers and fabrics

ID	Sample description	Current colour	HPLC–DAD Detected organic molecules	HPLC–DAD Biological sources
1	Velvet, heterogeneously faded border fragment at the bottom of the garden	Red	Ellagic acid, alizarin, purpurin, anthragallol and nordamnacanthal	Madder and tannin
2	'Fluffy' flowers, at the bottom on the right side	Red	Kermesic and ellagic acid	Kermes and tannin
3	'Fluffy' flowers, at the bottom on the right side	Pale (yellow)	Urolithin C and brasilein	Redwood
4	Velvet fabric around a roll, with almost completely deteriorated silk yarns	Red	Kermesic, flavokermesic and ellagic acid	Kermes and tannin
5	Velvet fabric around a roll	Light orange	Urolithin C	Redwood
6	Velvet fabric, in front of pedestal of a later added statue at the right side of the central statue	Red/violet	Carminic, kermesic and ellagic acid	Mexican cochineal and tannin
7	Velvet from a lozenge-shaped decoration (DS013)	Light orange	Urolithin C	Redwood
8	Flowers with very faded colours, in front of the statue at the left side of the garden	Pale (red)	Urolithin C	Redwood
11	Satin fabric around a roll	Dark red	Carminic, kermesic, flavokermesic and ellagic acid	Mexican cochineal and tannin
9	Silk from the leaves at the right border of the garden. The silk yarns have deteriorated badly	Yellow	Luteolin, apigenin, indigotin	Weld or equivalent and indigo or woad

This was demonstrated by two 'fluffy' flowers at the bottom right side of the garden, the first a red (sample 2) and the second a currently pale-yellow (sample 3) silk. The two flowers are technically similar, made with a technique resembling that used to make pompons (Figure 4, from which samples 2 and 3 were taken), although the silk dyes used in their making were clearly different. The red silk had been dyed with tannin and, interestingly, with kermes (*Kermes vermillio* Planchon), the most precious red dye source in medieval Europe (Cardon 2007, 609–19), while the pale yellow flower had been dyed with soluble redwood,[3] a dye derived from the heartwood of tropical *Caesalpinia* tree species. In the past, this dye was frequently used despite the knowledge that it was very vulnerable to light damage. Soluble redwoods from Central or South America might have been used, indirectly indicating a *post quem* dating to the beginning of the 16th century. Another possibility was the use of redwood from India and Southeast Asia, which during the medieval period in Europe was already imported on a large scale (Cardon 2007, 274–78).

Dye identification performed on other faded silk flowers, positioned in front of the alabaster statue of Saint Anne in the left part of the Garden (sample 8), confirmed the use of soluble redwood as the major cause of the severe colour degradation. Here too, only a few remains of red dye were present, in the areas of these flowers protected from light (figure 5 of flower with sample 8). Dye investigation also revealed that silk from the leaves of the flowers (sample 9) currently yellow, was originally dyed green using indigo or woad combined with weld (*Reseda luteola* L.) or an equivalent yellow dye source.

During the study of the dyes in other red silks, velvets and a satin, with hues ranging from light orange to red and violet, redwood was detected twice, again in the most faded samples (sample 5 and 7), while kermes was identified in the very deteriorated remains of a rolled-up velvet at the upper side of the garden (sample 4). The pronounced degradation of that fabric, in contrast to many other red, rolled-up velvet fragments from that garden, suggested that this was one of the oldest textiles and had not been later replaced by another textile wrapping. A dye from another scale insect, Mexican cochineal, was employed in a red velvet (sample 6) used to cover the pedestal of the statue of St Jerome positioned at the right side of the central statue and in a red, rolled-up silk satin (sample 11).[4] In contrast to kermes, the use of Mexican cochineal implies a dating from the beginning of the 16th century onwards (Cardon 2007, 619–32). Finally, the dye in a velvet used as a border at the bottom of the garden was identified as madder (*Rubia tinctorum* L.) (sample 1).

Figure 5. Silk flower, representing a carnation, with a spider, about 80 mm (sample 8)

Figure 6. Detail of a metal yarn gut membrane covered with a gilded silver layer, with a core yarn of S-spun bast fibres, dyed yellow with weld

METAL THREADS USED IN THE STRUCTURE OF THE SILK PETALS AND FLOWERS

Fine 'gold' and 'silver' metal threads, currently severely darkened by degradation, wrapped around a textile core, were abundantly used to decorate the silk petals and flowers. The compositional analysis of these metal yarns, part of a leaf decoration, demonstrated the use of gut membrane covered with a gilded silver layer, spirally S-wrapped around a core yarn of S-spun bast fibres, and dyed yellow with weld.[5] The gilded silver gut enveloped the textile core almost entirely, resulting in what appeared to be a very delicate 'golden' metallic thread (Figure 6). Sometimes such threads were also entwined, or the thread was twisted around a wire in either an open or a closed spiral, which produced different effects.

DEGRADATION OF THE SILK FLOWERS

The fabric making up the silk flowers had undergone considerable degradation. Dust that had permeated the smallest of crevices, holes and fibres proved to be one of the most serious causes of damage. Willemien Anaf (Anaf et al. 2020, forthcoming) has shown that the dust found in the Enclosed Gardens is composed of mineral-related particles (calcium-rich particles, silicon-rich particles and particles consisting of a mixture of various mineral-related elements). Dust harms fibres mechanically, as razor-sharp particles such as silicates can have a cutting effect on threads. In the artworks, the textiles and other organic materials had clearly suffered from detrimental chemical reactions (between the substance and the underlying layers, induced by moisture) and biological (fungal) damage. Fluctuations in temperature and relative humidity can cause shrinkage or expansion of the fibres and of parchment. Fraying of the silk had occurred first at the edges and then further along. Internal chemical decomposition of the silk thread had also taken its toll, including pulverisation of the white silk originally bleached with sulfur vapour.

Five hundred years of exposure to light had left visible marks on the organic material, and the silk flowers and fabrics had faded badly. In their original state, the Gardens filling the cabinets would have been a riot of colour, remnants of which could still be seen on the backside of the flowers inserted in the peat base (Figures 7, 8).

Figure 7. Wrapped peat bottom with inserted silk flowers at the side. Light exposure has caused colour fading

Figure 8. Verso side of the wrapped peat bottom shows the brighter colours of the silk

CONSERVATION OF THE SILK (FLOWERS, PETALS AND GREEN FABRIC)

Strictly necessary interventions for the treatment of the wrapped textile objects were given priority. These included removal of the thick grey layer of accreted dust, performed as carefully and efficiently as possible. Dusting was achieved with the aid of a fine brush and a micro-vacuum cleaner with adjustable suction and a micropipette (1 to 1.5 mm) used as a nozzle. Although the soft cleaning was successful, environmental SEM revealed that small dust particles, including some silk fibres, remained attached at the surface. However, a sufficiently thorough cleaning had to be balanced with optimal material preservation.

Broken silk threads were glued with Tylose MH300p to the underlying supporting structure of the silk-wrapped parchment or brass wire, using a very fine brush on key sites.[6] Before treatment, tests were executed with the cellulose ethers Klucel G (hydroxypropylcellulose; soluble in water and organic solvent), Tylose MH300p (methyl hydroxyethyl cellulose; water-soluble) and a natural polysaccharide Funori (made from seaweed *Gloiopeltis furcata*; water-soluble). An Oddy test confirmed the compatibility of the two cellulose ether adhesives with the brass wires.[7] The adhesives protected the brass as their alloy composition (76 wt% Cu, 23 wt% Zn and 1 wt% Pb) was the same as that of a large portion of the analysed wire samples from the Enclosed Gardens. The Funori glue did not yield convincing results. Finally, because the yarns did not bleed during moistening, Tylose MH300p was selected as the adhesive, because its adhesion strength is slightly higher than that of Klucel G in ethanol. The major disadvantage of using cellulose ether is its stiffening effect on flexible silk fibres. Where the yarn was wrapped around a parchment core structure, for example, the use of cellulose and the hardening effect on the fibres was less visually disturbing than in the case of almost completely detached wound structures, the fibres of which were not supported by a fixed structure. However, the conservators also applied Tylose in areas where, without treatment, the fibres would certainly have been lost during manipulation and the associated vibration. Flower stems in which the silk had loosened were treated similarly. Occasionally, mercerised cotton yarn was wound on top of the silk around the branches. This was done mostly at the tapering end of the stems, which were usually reattached to the peat base and invisible. Loose elements in areas that were difficult to access were reattached using a loop knot in fine two-ply silk thread.

CONCLUSION

Conservation of the Enclosed Gardens' historical layering was of utmost importance to the team of conservators-restorers. The Gardens' vulnerability was extensively documented, and fragile textile sections were stabilised to the best possible degree, with new supporting materials added discreetly. A study of the composition of the silk flowers and of the dyes used for different red-dyed silk artefacts provided additional information about the historical context of the unique Enclosed Gardens. The in situ treatment of these historical mix media ensembles, with their extremely small and fragile artefacts, in the Museum Hof van Busleyden was a challenge for art-historians and conservators and was only possible with the day-to-day involvement of conservation scientists and documentarists.

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NOTES

1 Digital microscopy (DM) was used to obtain high-quality images showing the complex and multi-material composition of the different artefacts. Scanning electron microscopy (SEM) images revealed the morphology of the fibres and the damage to them. The fibre type was identified from preliminary single fibres analysed using optical microscopy (OM) under transmitted light. The analysis required microsamples of the yarns 3–5 mm

in length. Similar microsamples of metal threads were subjected to element analyses using SEM–EDX.

[2] See KIK/IRPA analysis report (Vanden Berghe et al. 2017) for details on the HPLC–DAD analyses.

[3] Based on the identification of urolithin C (and brasilein in sample 3) (see Peggie et al. 2018).

[4] Identification of the Mexican cochineal species was based on the relative composition of the compounds detected with HPLC–DAD according to a procedure developed earlier (Vanden Berghe 2016). See KIK/IRPA analysis report (Vanden Berghe et al. 2017) for details on the HPLC–DAD analyses.

[5] Enclosed Garden of the Unicorn, silk flower BH1-V-036-ML-OL.

[6] The conservators did not test the application of the adhesive by using an ultrasonic humidifier, since most of the flowers were not dismantled and would not have been properly treated without touching adjacent objects and damaging them.

[7] Report PS01601OND, U Antwerpen, Patrick Storme, Faculteit Ontwerpwetenschappen, Opleiding Conservatie-restauratie Metalen.

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