

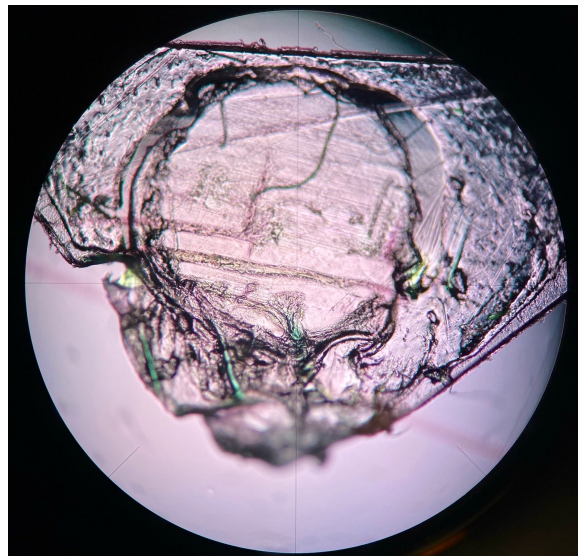


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METHOD APPLICATION OF PST-REMOVAL ON PRESSURE-SENSITIVE ADHESIVE LAMINATED PAPER

An Experimental Case Study



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Method Application of PST-Removal On Pressure-Sensitive Adhesive Laminated Paper:
An Experimental Case Study

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ABSTRACT

In this thesis the plausibility of applying methods and techniques for the removal of pressure-sensitive tapes (PSTs) in the delamination of pressure-sensitive adhesive laminations (PSA-laminations) is examined. The thesis also addresses if delamination is necessary and can be justified in regards to conservation theory, abiding to the concepts and notions of balance between material retention and material loss, reversibility, authenticity, and minimal intervention. A literature review and selection of PST-removal methods and techniques on a PSA-laminated research object is evaluated within a case study and set parameters that will be listed in the experimental design.

The study found that the application of PST-removal in the delamination of PSA-lamination is unsatisfactory, but that the yielded results did differ depending on the chosen technique and method. The study establishes that overall heat removal may be an appropriate candidate in the removal of PSA-lamination, but that further research has to be conducted, in particular for the removal of adhesive residue.

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Preface

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1. Introduction

This thesis examines and estimates the plausibility of applying methods and techniques for the removal of pressure-sensitive tapes (PSTs) in the delamination of pressure-sensitive adhesive laminations (PSA-laminations). The thesis also addresses if delamination is necessary and can be justified in regards to conservation theory, abiding to the concepts and notions of balance between material retention and material loss, reversibility, authenticity, and minimal intervention. A literature review and selection of PST-removal methods and techniques on a PSA-laminated research object is evaluated within a case study and set parameters that will be listed in the experimental design.

Definitions of terminology

Archive

Archives are institutions whose function is to chronicle documents that are thought to be important to preserve for the future. What separates archives from museums and libraries in their respective motivation to preserve objects, is that archives are closed to the public, but accessible once granted permission to enter the archive. However, no objects leave the archive. Whoever that is granted the access to archival objects, receive such permission on the condition that they remain on site, within the confined space of their collection or catalogue.

Juridical or legal authority may regulate the archival of objects in public archives. Please refer to the International Council on Archives' *'Principles for Archives and Record Legislations'* (2004) for further information on the matter.

Archival objects

Objects that are housed in archives differ in some ways from those that are housed in museums and libraries. Whereas museum objects are kept for both historical and artistic values whether that be in regards to aesthetics, art, or as a socio-political vehicle, the artistic value of archival objects is not a key issue in their preservation. Rather, there is an emphasis on their historical value that allows for recording of what is and has been considered to be worthy or beneficial to remember.

Although the difference between these two value systems can be considered slim, it is beneficial as a conservator to show awareness of this difference, and to understand within which value parameters objects in archives are preserved. A complete understanding of heritage valuation enables the conservator to address specific aims in their conservation treatment or lack thereof.

Universality

Universality is a concept that is foundational within the practice of conservation. Its definition is as followed, described by Muñoz Viñas: 'Universality – [is] the assumption that some heritage is meaningful to all of mankind' [1, p.69]. In this assumption, it permits the acknowledgement of an object, regardless of one's own personal relationship to it, as a part of the universal cultural heritage (Muñoz Viñas 2002, 26).

While it was held in higher regard by the time, the principle of universality has been debated in regards to ethics and its implication of colonial power structures. Please refer to Laurajane Smith's publications on the matter, such as Smith's 'Uses of Heritage' from 2006 or her and Natsuko Akagawa's 'Intangible Heritage' from 2009. Note, that universality is not included in the theoretical framework of this paper, but it is mentioned in relation to the digitization of cultural heritage (p. 21).

1.1 Background

1.2 Methodology: introduction to literature review

Light, heat, humidity, mechanical stress and pests are all included in the agents of deterioration for paper. In the field of conservation-preservation, active research has been conducted to evaluate methods that prevent these agents to accelerate, as well as to limit their influence on material objects inside collections. One of the methods from this research that addresses the specific needs that have been identified for paper, is a method referred to as consolidation.

Through the 19th to early 20th century (Kreuger 1995, 12), consolidation for paper consisted of a designed method called silking. In silking, a fine layer of silk was applied on top of an adhesive paste which coated the page. Silking could either be applied on a single side of the page, or it could be applied on its both sides. After silking, the page would continue to be legible and the silking was believed to operate as a protective barrier against fluctuations in the temperature and humidity of its climate. It was further believed, that the silking provided an additional protection for mechanical stress by distributing the structure and weight of the pages' paper mass.

Though the intention with silking was to help preserve the paper by the aforementioned benefits, time would reveal that said consolidation were not the miracle solution that it had been esteemed to be (Woodward 2017, 110). For it was found short later in time, that the silk would deteriorate sooner and more readily than the paper itself (Kreuger 1995, 13). The deteriorated silk would soon shrink, shatter, and darken in colour, and ultimately, the silk either came away from the paper (Ibid.). While silking did not necessarily result in damage for the paper onto which the method had been utilized, it did not consolidate the paper as it was thought. Furthermore, the deteriorated silk would come to compromise the paper's legibility and integrity by its discolouration. Consequently, it became relevant to devise a consolidation method that could come to dismantle and replace its predecessor.

Thus, following in 1936 to 1940, a new method to consolidate paper was invented. This method would become known as the Barrow lamination (Woodward 2017; McGath 2017; McGath et al 2015; Kathpalia 1973). It was named after whom the method was patented, namely William Barrow. In Barrow lamination, two films of cellulose acetate were sealed around the paper page through an adhesive. The adhesive was then activated by the high heat and pressure from a hydraulic press. A great feat of the Barrow lamination besides consolidation, was that the method were more time-efficient and thus required less resources to exert.

While Barrow's lamination was invented with the intention of wide-spread establishment, time would again reveal that nor was the Barrow lamination the miracle solution that conservators had anticipated. The methodical sequence of the procedure failed to be implemented within institutions (McGath et al 2015, 346; Woodward 2017, 113-114 & 118), and were modified until an arguable point of unrecognition (Ibid.). In other words, laminations since the Barrow lamination were introduced have not necessarily been regulated to the program procedure that William Barrow presented.

Thus, laminated paper objects from this period may consist of cellulose acetate, or they may not, while still being referred back to the Barrow lamination (McGath 2017, 16). Additionally, buffering baths to accommodate the pH-values of the paper may not have been performed (McGath et al 2015, 244; Woodward 2017, 119) before lamination as encouraged by Barrow (Woodward 2017), so far as to claim

that performing these baths is crucial for the success of and argued benefits from the lamination. These baths, of course, required further resources in time and funding, which may explain why it was common for conservators to not implement this in their lamination of paper objects.

In other words, a myriad of variations of Barrow's lamination has been performed and there is an uncertainty in determining what lamination method and technique a laminated object has undergone, even if the time and place of its exertion is known. Hence, there is an uncertainty in the lack of the understanding for laminated objects and what their prerequisites towards conservation and preservation are. While laminations became disputed during between 1970s to 1980s and dismantled before the shift of the century (Woodward 2017, 114; Molly McGath et al 2015, 333), conservators recognize and have identified a knowledge gap in how to take care of the objects that has been laminated prior to lamination's discontinuation.

1.3 Literature review

1.3.1 Laminating techniques: heat-set through to pressure-sensitive adhesive-set

As aforementioned, the plastic films utilized for laminations have traditionally consisted of cellulose acetate. However, alongside the rapid development of plastic films and tapes from its start in 1845 (Smith et al 1984, 101), other plastic films came to be used in laminations as well. As for the adhesive material, organic adhesives were used in the beginning and came to later be, not necessarily replaced, but concurring with inorganic adhesives.

Lamination can roughly be separated into two categories. The first category in which Barrow's lamination fall under, is mechanical lamination. In mechanical lamination, the adhesive mass is activated thermostatically with the usage of presses or laminators. As the transmission of heat activates the adhesive, the press or laminator furthers to soften the adhesive until the supply of heat discontinues, whereupon the pressure supports the adhesive to bond to the paper. Because it melts from the heat, the adhesive penetrates the paper, seeping into its pores and lodging into them once cool. Consequently, the adhesive can be describe to then permeate or having fused with the paper. Mechanical lamination may also be referred to as heat-set lamination.

One heat-set lamination, which came to be the first lamination used in archives, was the cellulose acetate lamination, or 'Barrow lamination'. Because cellulose acetate was utilized, this method would later be mistakenly referred to as cellulose acetate lamination (McGath 2017). Cellulose acetate laminations, whether pertaining to Barrow's method or not, were adopted by many paper conservators to consolidate documents as cellulose acetate were then qualified as appropriate laminating film for archival objects by the National Bureau of Standards, NBS; nowadays National Institute and Technology, NIST (Paper Catalogue 1982, 34). However, since lamination was discontinued as a conservation method, and arguably for this particular reason among others, is that there is no laminating film as of today that meet NIST's standards and specifications.

The other category of lamination is manual lamination. PSA-laminations would fall within this category, as these are pressure-set or cold-set. In manual lamination, a flexible support sheet is placed on a smooth, flat surface (Crespo & Vinaz 1984, 95). Examples of supports that are used, are Reemay®, Teflon®, and polyethylene (Ibid.). Then, a soft spray of moisture is applied to the document

that is designated to be manually laminated. The spray can also be replaced with a soft brush for greater control. The moisture softens the fibers and facilitates the following application of adhesive mass (Ibid.).

The adhesive is then applied, either by brush or a roller. The goal is to apply the adhesive as evenly as possible. Thereafter, a reinforcing sheet that has also been moistened using the same technique as described earlier, is placed onto of the coat of adhesive. When the reinforcing sheet has adhered, an impermeable support sheet is placed on top of the reinforcing sheet. Then, a light pressure by using a roller is applied onto the stack of sheets, in which the document is in-between, and ultimately put in a manual press (Ibid.). Note, that the press does not transmit heat, but rather only involves mechanical force from the pressure. Hence, manual lamination may be referred to as cold-set lamination, pressure-set lamination, or *tape*-lamination.

1.3.2 Lamination and conservation-preservation

Though laminations were once regarded as a superior method to conserve paper objects in archives with little to no risks of compromising the objects' longevity (Woodward 2017, 113), this hypothesis was disproven by findings in the 1970s relating to the deterioration process of polymers. (Ibid., 114).

Laminations were thought to provide stability and protection for the object leading to safer handling. This was until the discovery of hydrolysis which occurs in the laminate polymer material, resulting in a loss of the polymers' plasticizers (Littlejohn et al 2013, 417). The laminated object would then be too brittle to safely handle (Richardson 2014, 232) as the plasticizers would have become lost, causing the tissue to become stiff and inflexible (McGath et al 2015, 346-347; O'Loughlin & Stiber 1992, 3). In addition, the laminated object is entrapped to deteriorate from the oxidative gas that adhesives used in laminations emit.

There is also a risk of the entrapment of dirt and debris upon lamination, both of which are also deteriorating agents for paper due to their acidity. Because dirt and debris contain carbon atoms, they are also likely to build strong bonds to the paper. This could then require extensive treatment if the object were to be delaminated, in the removal of the dirt and debris or treatment of their plausible discolouration of the paper.

Accordingly, conservators have since then replaced laminations with encapsulation when appropriate to receive similar benefits that was once associated with laminations until its later findings. Though laminations are no longer performed by conservators today, the paper objects which have been previously laminated remain in archive collections. As with any object, it is the conservator's interest to preserve these laminated papers, thus prompting a demand to understand how the preservation of paper may operate even when the paper in question has been laminated, which in and of itself initiates deterioration.

1.3.3 History of delamination techniques

There is an agreement that laminations are irreversible. Thus, delamination does not equate to performing a reversal of effect of the lamination that an object has previously been assigned. From when laminations successively ceased to be performed by conservators towards the 1980s (McGath et al 2015, 353; Woodward 2017, 114; Ormsby 2003, 61), there exists a lack of written information on how and, arguably more importantly, *if* delamination is viable and appropriate in the preservation of laminated objects.

The most common method and technique of delamination that can be found in recent research papers is by immersion in acetone. However, it is specifically cellulose acetate (CA) and cellulose diacetate (CDA) laminations that are mentioned as candidates for this delamination method. The immersions has been described to involve a sequence of acetone baths that last only for a couple of minutes at a time (McGath et al 2015, 348; Kreuger 1995, 14).

Once in the bath, the CA or CDA swell and the interface between the CA or CDA and paper weakens (McGath et al 2015, 348). This consequently allows for the conservator to peel away the CA- or CDA-film from the paper that was once laminated. However, since acetone is an organic solvent, this method is not compatible with laminated paper objects with surface media such as ink, copy pencil, aniline dyes, and wax crayons, all of which are, too, soluble in acetone (Ibid.).

Through research it has been discovered that acetone will not however dissolve cellulose acetate once it has begun its deterioration process of chemical hydrolysis. It has however been found, as stated by the Paper Catalogue (1982), that hydrolyzed cellulose acetate have a greater chance to dissolve in acetone-water mixtures when proportioned from 10:1 to 4:1 (1), whereupon it could nonetheless be possible to utilize the delamination method of immersion in acetone-water baths. Furthermore, it has been noted that dimethylformamide (DMF) and ethyl acetate may possess the ability to dissolve deteriorated CA-film (Paper Catalogue 1982, 37), which may then be possible solvent candidates for delamination through immersion as well.

Yet, documentation on delamination for laminated objects that are not CA- or CDA-laminated is scarce and hard to find. As the undersigned author, such documentation and research has not been found despite the extensive literature search. It could be presumed then, that there are no official guidelines or established procedures for paper conservators to refer to if they are considering the possibility or necessity of delamination for a non-CA- or non-CDA-laminated object.

However, a method of delamination were recently discovered by Angelova at the National Archives in 2017 (Griffin & O'Regan 2019, 232) upon request to research about methods for the removal or delamination of area-bonded fibre (ABF). ABF consists of a nylon tissue that possesses a singular coat of synthetic acrylic adhesive. Angelova could attest to Griffin's and O'Regan's (Ibid., 244) experience and claim that lamination is near impossible to remove by mechanical methods alone as the adhesive remains. But in this Angelova found success in the removal of the nylon tissue carrier and synthetic acrylic adhesive by utilizing the vapour from acetone.

The acetone vapour were delivered to the ABF-laminate through Porelle® textile, which was placed with its smooth side face down over the ABF-laminated object. Porelle® shares qualities to both Gore-Tex® and SympaTex®, wherefore it can be used as an alternative for either two. Acetone was then applied with a soft spray onto the fibrous backing while Angelova held the Porelle® textile close to the object with the support of magnets that were wrapped in silicone release paper. Successively, more acetone would be softly sprayed in periods of time to retain adequate vapour (Ibid., 232).

It is thought that the success from Angelova's method of delamination for ABF-laminated objects could potentially apply to other objects that have been laminated with synthetic polymers.

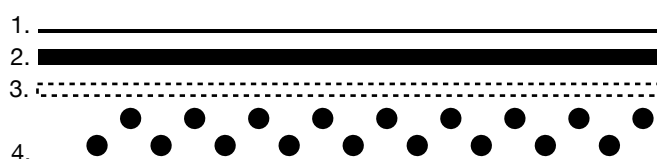
1.3.4 History of pressure-sensitive tape and its removal

As PSTs have been and continues to be commercialized, the supply and demand is shrouded in competitive secrecy. For conservators, it is difficult, if not impossible, to ever fully know all the chemical components and their amount percentages that make up for a specific PST. Every company have their own recipe, and since the recipe can either make or break their revenue, the full table of contents become confidential information. Hence, this information does not reach conservators that work outside the company factories.

What is applicable to all PSTs however, is that they are of a flexible product that is capable of adhering to surfaces with the use of light pressure. The product is typically composed of four layers, where there is an adhesive mass at the farthest bottom, then a primer coat on top, followed by the backing, and at last finished off with a release coat. The primer coat that lies between the adhesive mass and backing aids in binding the two layers together (Smith et al 1984, 101), whereas the adhesive mass itself adheres to the surface the tape is pressure-set on.

As aforementioned, the adhesive mass, primer coat, backing, and release coat that are used for tapes are not limited to one specific material or material type. Notwithstanding, materials that have been and are utilized for backings include fabric, paper, and plastic films such as polypropylene (Driussi 2017, 853; O'Loughlin & Stiber 1992). The most common PSTs that paper conservators encounter in their profession consist of two categories. Category one is natural and synthetic rubbers, also known as polyisoprenes. In category two, is acrylic monomers, like n-butyl acrylate, that have been co-polymerised with non-acrylics, such as vinyl acetate and polystyrene (Müller et al 2022, 59).

Similarly, adhesives that are used for tapes include acrylic copolymers, silicones, and natural as well as synthetic rubbers. In archives, the most common tapes to come across as a conservator are fabric tape and masking tape, magic tape, cellophane tape, and Filmoplast P and P90, both of which are referred to as archival tapes (Trabace et al 2017).



[Fig. 1] Four layers of a typical pressure-sensitive tape.

1. Release coat
2. Backing
3. Primer coat
4. Adhesive mass

Based on the illustration from *Pressure-Sensitive Tape and Techniques for Its Removal From Paper* (Smith et al 1984, 101).

Towards the end of the 1920s, PSTs were adopted by practitioners in museums, libraries and archives (Bakalarou & Trabace 2017). As found in The National Archives, the usage of PSTs included in repairs if tearing and material loss, coverage or alterations of text in documents, and coverage or alterations in

books and photographs (Ibid.). Occasionally, PSTs would be utilized for writing support in the annotation of an object, or to become a part of the artwork itself (Ibid.).

These additions and alterations would later reveal themselves to be inappropriate at best, as the deterioration of the PSTs and its acceleration of the paper objects' and their potential surface media's deterioration (Mirabile et al 2020, 2) were detected. Furthermore, the usage of PSTs becomes controversial when these obscure or alter the recorded information that is provided by the affected documents, photographic images, and artwork. Once obscured and altered, the authenticity of the object is compromised and it would not be beyond reason that the information and value that was once known will be or will become lost.

Whether by chemical deterioration or disassociation, there are thus causes of concern to address the possibility of necessary removal of PSTs. The methods of removal that has become the most common as of today can be separated into two categories. In category one are dry techniques, which utilizes heat, silicone paper, and tools such as bamboo sticks, spatulas, erasers, and scalpels. In category two are wet techniques, which utilizes solvents. The solvents may be applied directly onto the object by pipette, brush, gel, or poultice, or indirectly by vapour.

A combination of techniques is also feasible. For example, utilizing heat as one of the dry PST-removal techniques will allow for the PST to detach from the paper support, and as its adhesive softens, mechanical removal by the use of tweezers could be conducted in a successful removal of the tape. Dry and wet removal techniques can also be combined with each other, such as mechanical removal of adhesive residue after the backing of the PST has been removed, which were before its removal subjected to the solvent vapours of an acetone gel.

As with any conservation treatment, there are associated risks with each respective method. For example, tweezers might not successfully pull off the adhesive mass of the PST, leaving a notable amount of adhesive residue on the surface. Spatulas, bamboo sticks, erasers, and scalpels can cause creasing, tearing, and other variations of abrasion from the friction that occurs when mechanical force is applied to the paper. Wet removal techniques, on the other hand, heightens the risk of discolouration and tidelines from added moisture if it moves laterally through the fibers of the paper. Tidelines may also occur from the presence of impurities such as dirt when these are dissolved by the solvent. If present, the oxidation of the short-chain cellulose may also cause tidelines. Breakdown products or fillers and additives from the premixes utilized in the manufacture of the paper also factor in the risk of tidelines upon wet treatment. Furthermore, if a concentrated transport of water occurs at the wet-dry interface of the paper and it remains concentrated in place as the moisture evaporates, discolouration or a so called 'halo' effect could occur (Mirabile et al 2020, 2). Additionally, said concentration of material imposes the risk of initiating oxidative reactions that deteriorates cellulose, which then produces yellow-to-brown degradation products (Ibid.). Naturally, all of these consequences upon either dry or wet removal of PSTs ultimately impacts the appearance and physical stability of the paper.

Paper with surface mediums such as ink may also bleed, skin, or vanish if the medium is soluble by the solvents used for the removal (Ibid.). Solvents that are used in the removal for PSTs include the following in either concentrated form or, if compatible and miscible, in mixtures of water: water, ketones (acetone), esters (ethyl acetate), alcohols, 'white spirits', cyclic ether (tetrahydrofuran), and aliphatic hydrocarbons (cyclohexane) (Smith et al 1984, 104). Among these, cyclohexane is the only

solvent that does not readily dissolve surface mediums such as inks. However, Mirabele et al note that methods of removal that do utilize solvents oftentimes involve organic solvents that are either volatile or toxic to the practicing conservator or the environment, if not both (Mirabele et al 2020, 2). Naturally, this is another cause of concern for conservators in using the aforementioned organic solvents.

However, a recent addition to the methods and techniques for PST-removal has been invented and developed in the framework of the NANORESTART project (H2020-NMP-21-2014/646063) that was conducted within the Research Centre CSGI at the Chemistry Department of Florence University in close collaboration with Antonio Mirabile, a paper conservator and consultant in preventive conservation.

The method of PST-removal that was discovered and developed utilizes organogels that are saturated with diethyl carbonate (DEC), which is considered to be one among the 'green' solvents available in today's market. Organogels, as its name suggests, consists of a chemical gel that possesses the capability of having their polymeric network saturated with solvents or solvent mixtures. Their saturated polymeric network then emits vapour from the solvents or solvent mixtures gradually onto the surface of the object of which the organogel has been applied on. Due to their confinement, the usage of organogels prevents risks that are associated with the uncontrolled emission of vapours from the used solvent(s) or solvent mixture(s). Such risks include migration of the artistic technique or surface medium of the object, as well as harmful risks for the conservator's health as the evaporation rate of the solvent(s) or solvent mixture(s) is decreased.

DEC had no previous history of usage in the field of conservation at this time (Driussi 2017, 850-852), but based on the project results, it has the potential of becoming implemented by conservators in their practice if further research is conducted.

PSA-laminations are interesting in that they can be likened to PSTs. Conservators have agreed that PSTs pose a challenge in the preservation of objects onto which PSTs have been adhered, so far as to be of top priority as of today (O'Loughlin & Stiber 1992, 5). However, whereas research has been conducted on potential methods and techniques to remove PSTs, such research is scarce or difficult to find on PSA-laminates. If PSA-laminations share qualities and characteristics with PSTs, PSA-laminates would naturally also be of concern in the preservation of PSA-laminated objects.

1.4 Problem statement

Issues involving laminations of paper objects began receiving recognition in the 1960s and by the 1990s were widely proclaimed as an inappropriate attempt at safeguarding the objects. Consequently, lamination ceased to be regarded as a conservation treatment, but the prior laminations that has been performed on culturally significant objects cannot be undone without significant risk of destruction and material loss.

While lamination has been marketed as a reversible treatment (Woodward 2017, 117), it has been concluded that laminating objects has proven with time to restrict the possibility of their preservation (Zervos & Alexopoulou 2015, 2879). Thus, conservators have agreed that lamination is not to be performed.

While the field of conservation has acknowledged the harm of lamination, paper objects that have previously been laminated remain in collections today. Their existence in collections then, present a non-negotiable challenge to today's conservators (Strlič & Curran 2014, 189), as their lamination continues the need to be addressed and assessed in the preservation of said objects.

Identifying an appropriate approach to preserve these objects is necessary as to extend their life as far as possible, while also allowing the integrity of the object to be retained. Delamination becomes more difficult as hydrolysis of the laminate polymer progresses (McGath 2017, 20), and it is therefore desirable to soon understand how such objects can be preserved for the future before they degrade too far.

Delamination of laminated objects has been utilized to help preserve once laminated objects. However, research remains to establish an official guideline of procedure for how one is to optimally delaminate a laminated paper object (Page 2003). This applies to both heat-set laminated objects and pressure-sensitive adhesive laminated objects alike. Research also remains to examine if delamination in and of itself is an appropriate treatment, as it may cause greater harm than good.

Thus, this paper intends to investigate if the removal of pressure-sensitive tapes (PSTs) can be applied in the delamination of pressure-sensitive adhesive laminated paper. Consequently, this thesis will present a selection of known methods and techniques that are utilized PST-removal and assess if said methods and techniques could be applied to the delamination of PSA-laminated objects. The thesis will also assess if delamination is necessary and can be justified in regards to conservation theory, abiding to the concepts and notions of balance between material retention and material loss, reversibility, authenticity, and minimal intervention.

1.5 Aims and objectives

The aim is to investigate if techniques developed for removal of PSTs can be utilized in the removal of pressure-sensitive adhesive laminate from paper objects. The following objectives below will be completed to achieve this aim:

1. Complete a literature review to document the development of lamination techniques and pressure-sensitive tape over time.
2. Complete a literature review of conservation treatments for reversal of lamination or delamination and removal of pressure-sensitive tape.
3. Explore the theoretical and practical conservation implications of delamination from a professional ethical position.
4. Source, characterise, and document a suitable laminated paper object for experimentation.
5. Conduct a range of delamination treatments (including pre-treatment solubility testing of media) to assess the most appropriate method(s) based on parameters derived from published technical and ethical literature.
6. Assess results from delamination experiment based on the given experimental parameters. See chapter 2.2.

1.6 Scope and limitations

It is discussed whether laminated objects are to be delaminated, which causes physical stress on the object (Woodward 2017, 120), or if they are to be left as is but stored in optimal conditions under supervision and successive condition reports (McGath 2017; Puls et al 2011). This paper will address the foregoing, with aim to become aware of and get acquainted with the procedure of delaminating an object that has its condition and/or integrity compromised by its PSA-lamination and assess if the methods and techniques associated with the removal of PSTs can be applied to PSA-laminated objects. A complementing study on how to store said objects when preferred over delamination, is up for consideration and a likely extension in the future of this research. However, due to the limited time that is available for this research, this paper will not include a section of research in regards to collection management of laminated objects.

Because the research object involves ink as a surface medium, a mandatory bleeding test will be performed and will also be regarded in the estimation of how appropriate the chosen methods and techniques for the removal of PSTs that involves solvents were.

The research of this paper will not concern the detailed research of the material characterisation of the research object. That is, the paper will concern the methodology of applying associated PST-removal techniques on PSA-laminated paper, accompanied with a brief overview of the research object.

1.7 Theoretical framework

With the requirement of processing empirical data obtained by laboratory experiments, this paper will operate on a foundation of mixed theory organised into a sequential explanatory design (Creswell 2013).

In sequential explanatory design, the data is collected in two consecutive phases. As mentioned, it is a mixed method design, with one initial phase of quantitative research (data collection). The initial phase is then followed by quantitative analysis of the data. Once said analysis is done, the second phase of qualitative research follows. In the same vein, when the qualitative data has been collected, it analysed qualitatively. In the context of this paper, the initial quantitative phase consists of identification of the plastic material and adhesive material of the research object, documentation of said object, and the application of methods associated with the removal of PSTs on PSA-laminated objects. The second qualitative phase consists of interpretation and assessment of said results with the assistance of a literature review over (PSA-)laminations and PSTs, adjacent with conservation theory.

The experimental design operates within the parameters of induction, where a conclusion and summary are derived through foregoing experiments and observations under empirical observation. That is, the research has an initial planning phase after which the collection of data is performed. Once collected, the collected data is analysed within given parameters (see: p. 34) and processed into a conclusion through discussion that directs to the problem statement.

1.7.1 Conservation theory

In addition to this scientific theoretical framework, the theoretical framework of preventive conservation will also be regarded in this essay. Conservation is not merely a set of active measures such as directly retouching the surface of an object or indirectly conserving an object by housing it in a

regulated climate and environment. Rather, conservation consists of both activity, direct and indirect, as well as a lack of activity. That is, the most appropriate method and theoretical framework within conservation, can sometimes be to do nothing but indirect actions in order to conserve an object in regards to the object's integrity and thus individual needs.

This paper concerns active conservation through the practical application of methods in the removal of PSTs for the delamination of PSA-laminated objects. As aforementioned in the scope and limitations, preventive conservation will not be utilized or researched in this paper, as this paper intends to answer the question if PST-removal can be applied onto PSA-laminated objects. Thus, this paper will not address preventive conservation for PSA-laminated objects, such as collection management and the optimal storage of said objects in the surrounding climate and environment. Therefore, conservation theory regarding collection management will not be included in this chapter.

1.7.2 Balance of material retention and material loss

The active conservation that will be performed will be judged and assessed within operation of a contemporary conservation principles and code of conduct. One principle at the forefront, is that of minimal intervention, in which intervention is needed, concerns the balance of material retention and material loss.

The balance of material retention and material loss when applied to PSA-laminated objects involves many things. For example, in the case for PSA-laminated objects that have a written or drawn surface medium, there is a risk that the medium will bleed, diminish, or even vanish upon delamination. Such risk compromises not only the aesthetic value of the object, but potentially its legibility as well. Its legibility may concern something as straightforward as being readable or otherwise decipherable, but it may as well concern its legibility to the observer as an object in and of itself.

An object whose legibility has been compromised, can be compared to a manifestation of a loss of context. Such loss submits to the deterioration of disassociation. Disassociation in this context, describes the process of a when a valuable object loses its value, as it can no longer be understood and thus acknowledged or recognised as valuable. For example, a manuscript that chronicles a significant historical event is no longer readable after its writing in ink has bled, and thus the manuscript becomes nothing but a page of paper with indecipherable ink blots. Similarly, the erasure of a name on a paper document that is significant in the affiliation or recognition of a community, would through disassociation become a document about whomever. Hence, disassociation is in which an object, regardless of valuable it once was, becomes unrecognisable. Such object loses its identity and privilege as an esteemed object, and with that it becomes and may remain forgotten until lost forever. Because disassociation implies such severe consequences, it is of great importance that preventive measures against disassociation is implemented in active attempt to prevent it from occurring.

1.7.3 Authenticity

The risk of material loss is countered with the possibility of repairing any holes, tears, and other losses with materials such as Japanese tissue paper and wheat starch (AIC Conservation Wiki) or heat-set tissue that has been toned with Liquitex Acrylics (Kreuger 1995 , 14).

However, such repairs do affect the perceived authenticity of the object. It also imposes upon its self-sovereignty, in which the object exists regardless of its relationship to the individual or how it is exhibited and used in the practice of cultural heritage. Kathpalia (1973) advocated, that one should never undertake oneself the assignment to fill in or otherwise alter a written text or configured image that has experienced material loss, as this could result in overwriting or re-writing the history of the object (83). It is argued, that it is better to accept this loss and implement efforts to prevent it from occurring again in the future, than it is to presume that one knows the object better than it knows itself (Kathpalia 1973, 81-82). Furthermore, introducing new material to an object can cause physical or chemical stress as the object is handled. The introduction of new material, then, is at odds with the concept of minimal intervention.

The concept of authenticity, however, is not necessarily anchored in the material like in the example above. Western thought of authenticity does often imply a correlation to the material and that material retention is the foundational practice for a conservator to heed and care for an object's authenticity. But in Japan for example, authenticity extends beyond the material (Larsen 1992). There, it is the meaning for why and under what circumstances the object exists that speaks to the authenticity of an object (15). Its material existence, i.e. *that it exists*, comes second-place. Hence, it is not uncommon that the building material of a Japanese temple is successively replaced with new building material of the same kind. For the Western concept of authenticity, this means that the temple is no longer 'original' once all the building materials from its origin have been replaced (4). But within Japanese culture, the temple retains its authenticity as its appearance and its function is protected and cherished by this practice (16).

1.7.4 Minimal intervention

Due to the strong awareness among conservators that small interventions can and do change the object, contemporary conservation strives for minimal intervention as to safeguard objects from stress and potential material loss from extensive treatment. This is reflected in the research and development of methods, materials, and preventive measures utilized within conservation. It is also reflected in the common question that conservators are expected to reflect upon and answer before conducting any treatment on an object—what motivates this treatment, and what achievements can be expected?

Minimal intervention must however still guarantee that the end goal of conservation is achieved. That is, that the object is preserved (Muñoz Viñas 2005, 188ff). Ideally, a conservation treatment would be both reversible and sustainable. However, complete reversibility has been acknowledged as unattainable to achieve, since every intervention naturally changes and alters the object. An intervention may be of small degree, but once culminated as the object continues to be preserved for the future, the accumulation of small interventions becomes a large one. Furthermore, minimal intervention requires that the objects are in an environment where the conservator has the opportunity to regain control, which cannot be promised with certainty due to human flaws. Therefore, it is important that there is an opportunity for the re-treatability of an object.

Muñoz Viñas' skepticism towards the existence of the concept of perfect reversibility in conservation is addressed with equal amounts of theoretical and technical points of view. In this skepticism, the following quote from Schinzel is provided in Muñoz Viñas' discourse regarding the unattainability of reversibility (Muñoz Viñas 2002, 25):

”...the belief in reversibility may show, and even be, a

fashionable naivety due to unhistorical thinking; the illusion is that something can be undone, which may lead to a lack of responsibility. Paradoxically it is exactly because nothing can be undone that we have to work according to the rules of reversibility, while not forgetting the fact that reversibility is Utopian [14, p.45].”

1.7.5 Delamination: reversibility and re-treatability

Lamination has been referred to as non-reversible since its discontinuation. However, prior to this, lamination as a conservation method was regarded to have belonged among reversible conservation treatments (McGath et al 2015, 334 & 348). Its end of being referred to as a reversible treatment is, nonetheless, a subject of the individual attitude to the notion of reversibility in and of itself.

Griffin and O'Regan (2019) explain that conservator Barbara Appelbaum stated in a paper for the Journal of the American Institute for Conservation in 1987, that '[reversibility] does not require that the object be identical to what it was, only that we can return it to a state where our treatment choices are as broad as they were before the treatment in question was performed' (230). In this, Appelbaum means that the reversibility of a treatment exists within the possibility of removing the material that has been added to the extent that another material in the future can be used or introduced to the object without discretion to its previous treatments (Appelbaum 2007, 357). Applebaum's definition of reversibility, however, is up for debate, as Griffin and O'Regan (2019) explain that such description may be a better definition of the concept of 're-treatability' rather than the conventional definition of reversibility (203).

While lamination can be dissolved by solvents in the family of white spirits (Griffin & O'Regan 2019, 231), it would be inappropriate to refer its solubility as a possession of reversibility. For example, the laminate tissue being soluble by or in white spirits does not promise that the paper tissue underneath remains in the same state as it was before it had been laminated. In addition, any surface medium on the paper, such as inks or graphite, could either bleed or completely vanish once in contact with the white spirits. As it has been established by Griffin and O'Regan (2019, 244) that laminations are difficult if not impossible to remove with mechanical force alone, it would be inappropriate to presume that the mechanical delamination of an object would not require additional delamination methods, like that of the usage of solvents. The application of solvents, particularly when the application involves immersion, is generally the best option of delamination in regards to reliable results, efficiency, and cost in time and economical expenses (Smith et al 1984, 108). Nonetheless, endorsing it as the best option does not automatically equate to endorsing it as an adequate option.

With PSA-laminated objects, their pressure-set lamination technique shares similarities with tapes. The physical similarities become relevant as they both consist of at least one carrier, which covers the adhesive mass underneath it. There is a consensus in the discussion between conservators, that the removal of PSTs is highly difficult and unless leaving the tape compromises the object's longevity more than it does to remove it, a conservator is discouraged to attempt to remove them due to its severity (Smith et al 1984, 113; Bonelli et al 2018, 5932).

Another case against delamination, is that if there is a presence of surface mediums on the paper that has been laminated, it is unlikely that an initial solubility testing of the medium will be allowed before the delamination. Therefore, if solvents are utilized in the chosen delamination method, there is a risk

that the surface medium will bleed, skin, or vanish upon contact with the solvent (Mirabile et al 2020, 2; Bonelli et al 2018, 5932). Surface mediums such as inks are organic materials, wherefore organic solvents like acetone are likely to dissolve them. It has further been established that plastics are not susceptible to dissolve by inorganic solvents when delaminated (Angelova 2017). The risk of loss and alterations in the surface medium is therefore inevitable and cannot be mitigated unless a method and technique of delamination that does not involve solvents is used.

Tearing and other damage or loss of the surface medium could occur by other methods as well. For example, using mechanical removal with a scalpel, bamboo stick, or spatula, the surface medium could receive cuts and abrasion. Another example would be the removal by an overall or local application of heat, which could melt or crackle the surface medium once it hardens after the supply of heat has ended. The surface medium could also potentially fuse with the plastic as it melts from the transmitted heat, whereupon it could be torn off of the paper entirely once the plastic sheet has been lifted.

Another cause of concern, is that if the removal of the backing of the tape would be successful, the adhesive mass may still reside on the surface or even inside the pores of the paper substrate (Mirabile et al 2020; McGath 2017; O'Loughlin & Stiber 1992). The removal of PSTs adhesive mass is an even greater challenge due to the aforementioned fact that the adhesive possesses the ability to penetrate the paper, which for laminations could be either through heat-transmission (McGath 2017, 17; Woodward 2017, 111) or through pressure (Griffin & O'Regan 2019, 230).

To remove everything but the adhesive mass of a PST is inappropriate; the adhesive mass has acidic properties which will deteriorate the paper, and if the adhesive still possesses at least some of its adhesive qualities it could adhere dirt and debris to the paper. This partial delamination in which the adhesive remains, could also be referred back to the ethical thought of cancelling a conservation treatment mid-way, whether that be because of a sudden shortage of resources or because of severity in performing the required conservation method (Appelbaum 2007).

In regards to the delamination of PSA-laminated objects, which like PSTs involve the presence of adhesive, delamination could hence potentially accelerate the deterioration of the paper object. Even if not, delamination of PSA-laminated objects introduces multiple associated with the different methods and techniques of PST-removal. Because the adhesive mass of PSTs is challenging to remove, it is likely that the adhesive of PSA-laminations are too and that there will be adhesive residue after delamination. Adhesive that is exposed to the atmosphere, will readily begin to oxidate, upon which the paper object it permeates lowers in pH from the acidic vapours that the adhesive is releasing (Mirabile et al 2020, 1-2; Smith et al 1984, 103). Because of this risk of partial removal, it is of highest importance to confirm that there is an adequate amount of resources in terms of time and funding so that a complete treatment of removal can be conducted. But as it has already been established, it is debatable if a complete removal is even possible because of the adhesive's nature.

1.7.6 No intervention

Leaving the lamination, however, also imposes risks of harm to the object. PSA-lamination consists of plastics and adhesives, both of which readily deteriorate under physiochemical situations. These situations include, as listed by Yash Pal Kathpalia (1973, 21):

- Exposure to heat and to light exposure to moisture

- Exposure to frequent and pronounced fluctuations in temperature and relative humidity within its surrounding atmosphere.
- Acidic impurities, such as air pollution and dust. Acidic impurities are also accounted in the presence of strong alkalis, which contribute to the acidic deterioration of paper by, for example, encouraging growth of fungi and mould.
- Presence of oxidising agents, such as oxygen, hydrogen peroxide, and sulphuric acid.
- Presence of heavy metals, as these can catalyze oxidative deterioration, consequently deteriorating the paper. The presence of heavy metals may cause this either by direct contact, such as a metal clip holding a set of papers together, or indirect contact, i.e. through the atmosphere as oxidants are released.
- Presence and usage of acidic sizes, such as alum and rosin.
- Presence and usage of acidic inks, such as iron gall ink which produces the aforementioned oxidant, sulphuric acid.
- Presence and usage of non-cellulose lignin materials or materials with low cellulose contents, as these typically either possess an acidic nature or yield acidic derivatives when these deteriorate.

PSTs possess a chemical instability that causes them to require little to begin deterioration processes, and paper is susceptible to also deteriorate when an interaction takes place between the two. The adhesive mass in PSTs are typically acidic, which will gradually oxidate and thus stain and weaken the paper as it too becomes more acidic from the adhesive's oxidants (Müller et al 2022, 60; Mirabile et al 2020, 1-2; Smith et al 1984, 103). The adhesive mass is also susceptible to become tacky as it penetrates further into the fibers of the paper, making it sticky and oily (Mirabile et al 2020, 1; Bonelli et al 2018, 5932; Smith et al 1984, 102). At its final stage of deterioration, the adhesive hardens, becomes discoloured, and loses its adhesive qualities, whereupon the tape may peel itself off of the paper. Such peeling may cause abrasion and tears in the paper, which eventually results in material loss. In case there is a contemporary ink present as a surface medium on the paper, the adhesive could cause damage such as bleeding of the ink if the adhesive contains solvent-based acrylics (O'Loughlin & Stiber 1992, 4). The bleeding may then soak through the paper and bleed onto adjacent materials, furthering the staining.

1.7.7 Digitization of cultural heritage

Digitization of cultural heritage such as photocopying manuscripts and other paper page objects has become a natural current topic among conservators as digital resources advance in their development as well as their accessibility to be utilized by both institutions and the common man. By digitizing an object, one may evade the necessity of an intervention that would impose too great of a risk for damage and deterioration. It could also reduce the need for physical handling, which in long-term becomes a sequence of many small instances of mechanical stress and allows for accidents to occur. Furthermore, the photo-scanned object could potentially then be stored in closer to optimal conditions within a regulated climate of temperature and relative humidity, as well as shielded from other deteriorating agents such as light, pests, and debris.

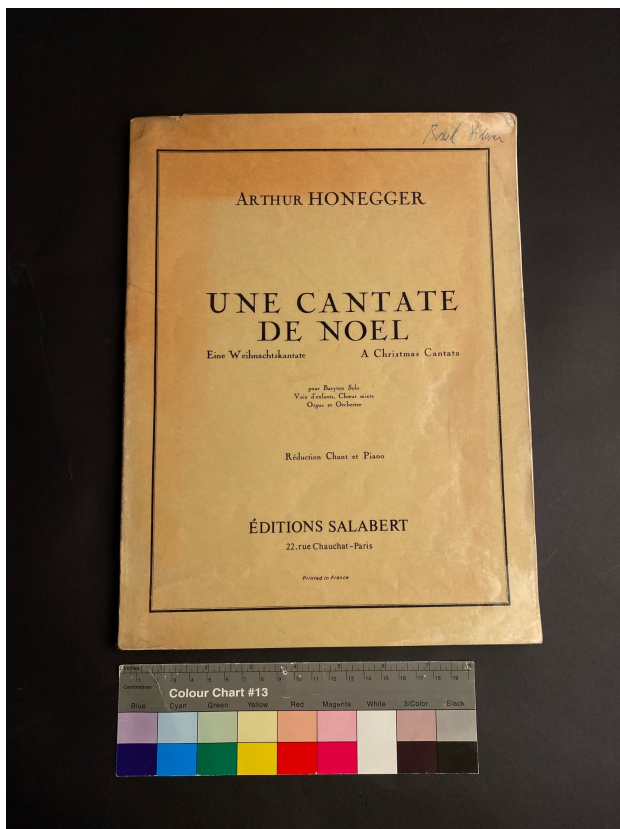
Apart from preserving the photo-scanned object until an indefinite future with few to none physical consequences for the object, digitizing collections could allow for greater participation from the public as the collection becomes more accessible for the public. The greater accessibility can result in benefits such as enabling research, allowing for the knowledge to reach out faster and farther than before, and of course induce personal meaning to the individual to whom the objects speak to. Individuals who

may not have had the opportunity to partake in the observation and knowledge of an object. For example, someone may have not have the opportunity by their economical or social status, or by physical disabilities that may not be permit them to enter or move around in the building where the object is located. The digitization of collections can thus be argued to be a natural progression of society and in the recognition of a universal cultural heritage, a concept which participates in the conservation theory and its discourse (Bakalarou & Trabace 2017).

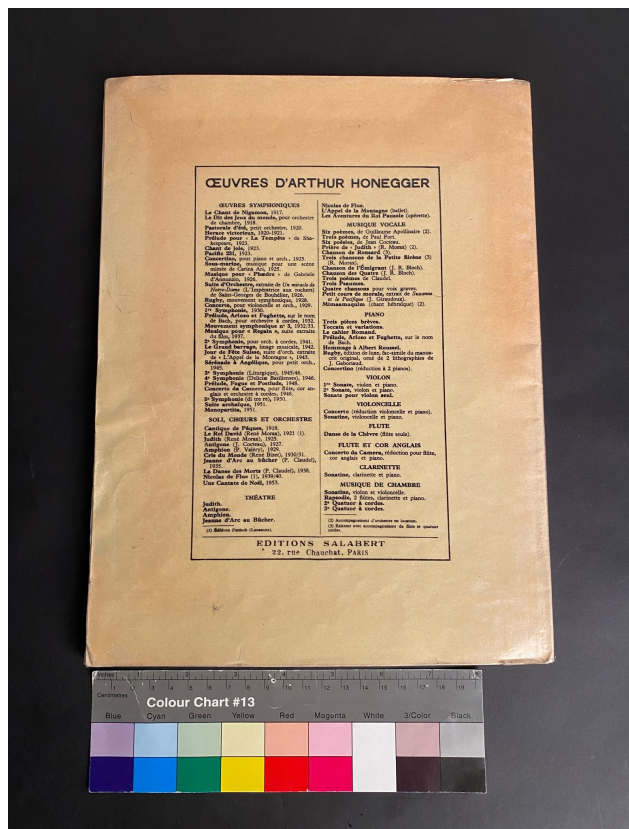
2. Materials and methods

2.1 The research object

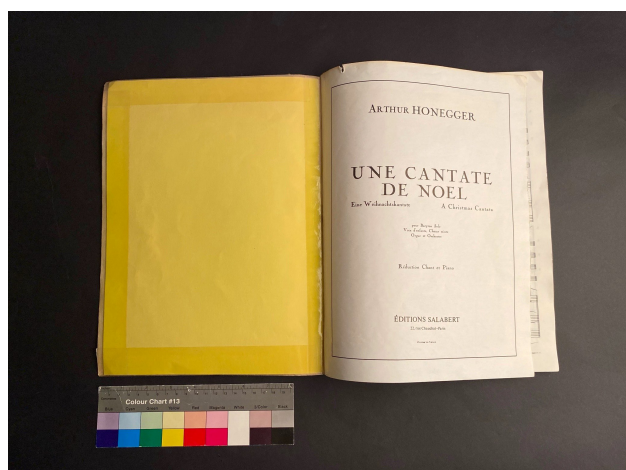
The research object for this study is a 53-page sheet music booklet titled 'Une Cantante de Noel' by Arthur Honegger. The booklet was printed in France in 1980. The cover describes its edition as the 'Éditions Salabert, E.A.S. 15630'. Its text is predominantly printed in French, with an additional translation in German and in English. The dimensions of the booklet are 318mm x 240 mm. While the cover of the sheet music booklet has been laminated with pressure-sensitive adhesive laminate tissue, the interior pages of the booklet have not been laminated. There are notations and highlights in pencil and India ink on the interior pages.



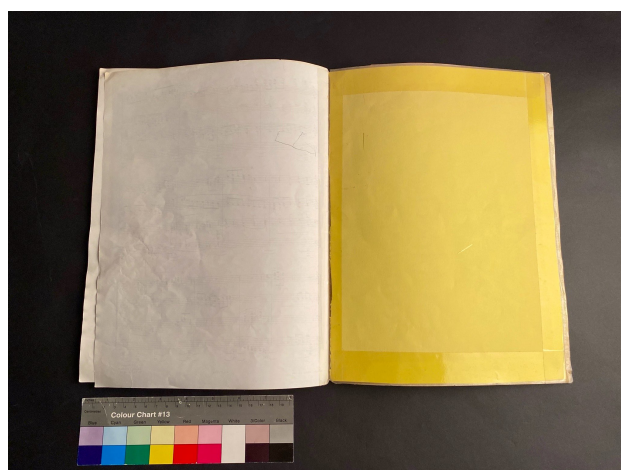
[Fig. 2] Front page of cover.



[Fig. 3] Back of cover.



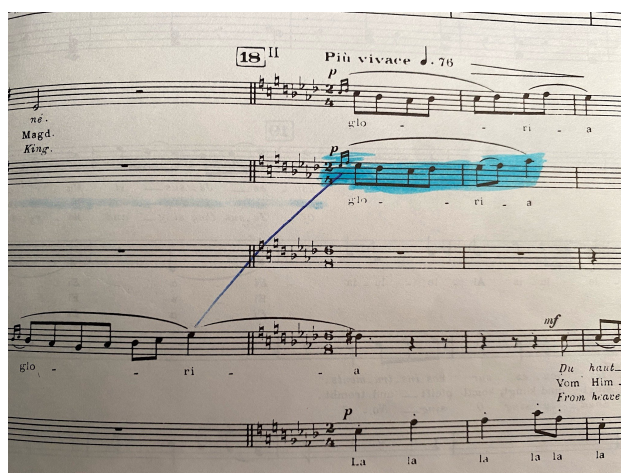
[Fig. 4] Front page, opened.



[Fig. 5] Back of cover, opened.

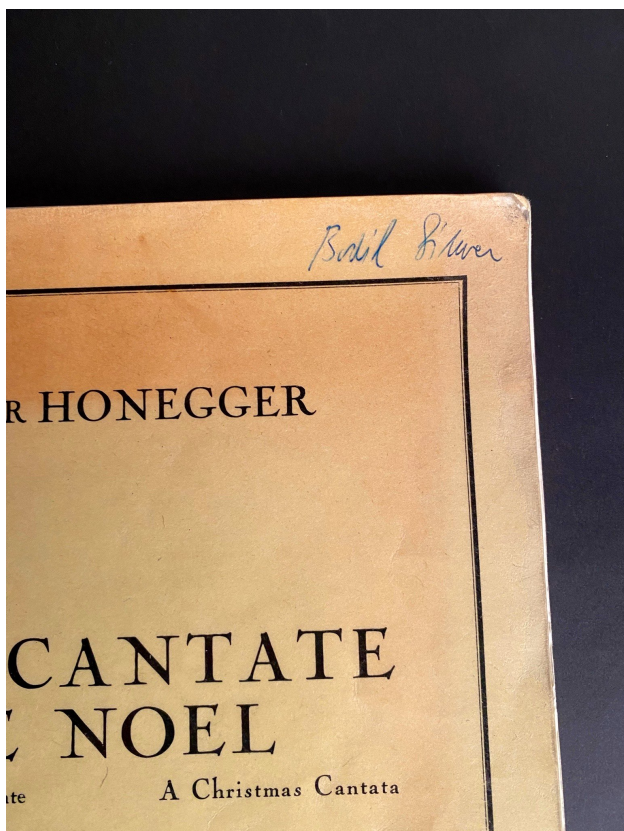


[Fig. 6] Interior pages with notations inside.

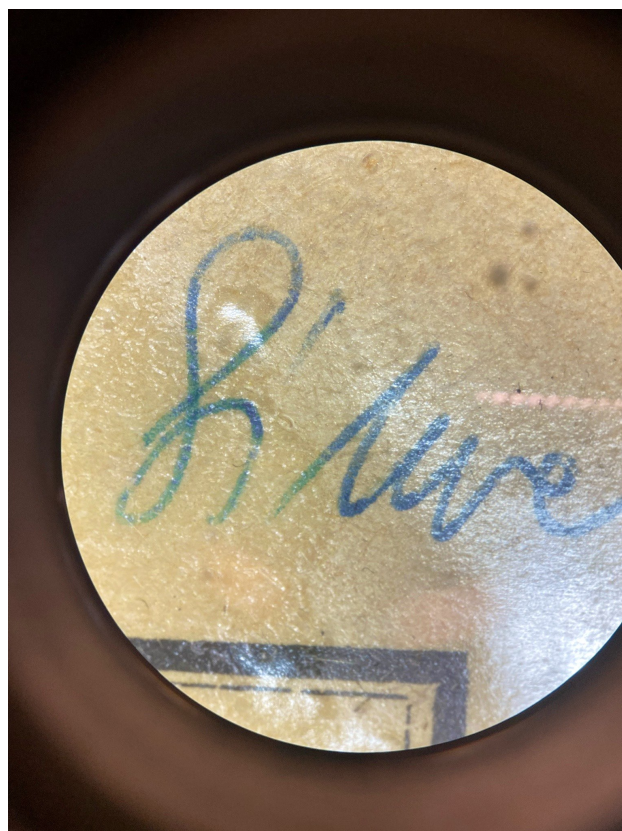


[Fig. 7] Close-up of notation.

The lamination has been sealed by wrapping and pressure setting the laminate plastic around the cover pages. A supportive reinforcing paper is visible underneath the laminate. Based on its divergent appearance and material properties, the reinforcing paper is not of the same kind as the cover page or the interior pages. It is not known if the reinforcing pages are an early or later addition. The name written on the upper right corner of the front cover page suggests that the lamination was a later addition, as the name has been written underneath the lamination and not on top of it. However, this cannot be adequately determined due to the absence of prior documentation.



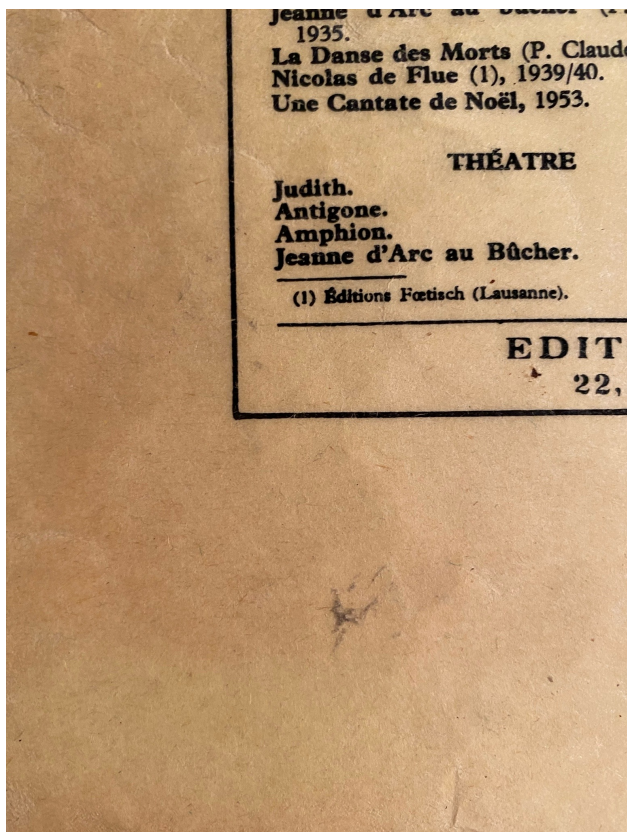
[Fig. 8] Ink surface medium.



[Fig. 9] Ink surface medium under microscope.

The PSA-laminated cover showcases slight planar distortion, as well as scuffed edges and large accumulations of dirt that has been trapped underneath by the adhesive. The lamination has lifted in several corners, all of which suggests that it could be due to the mechanical stress that has been subjected to the booklet from having its pages turned with repeated usage.

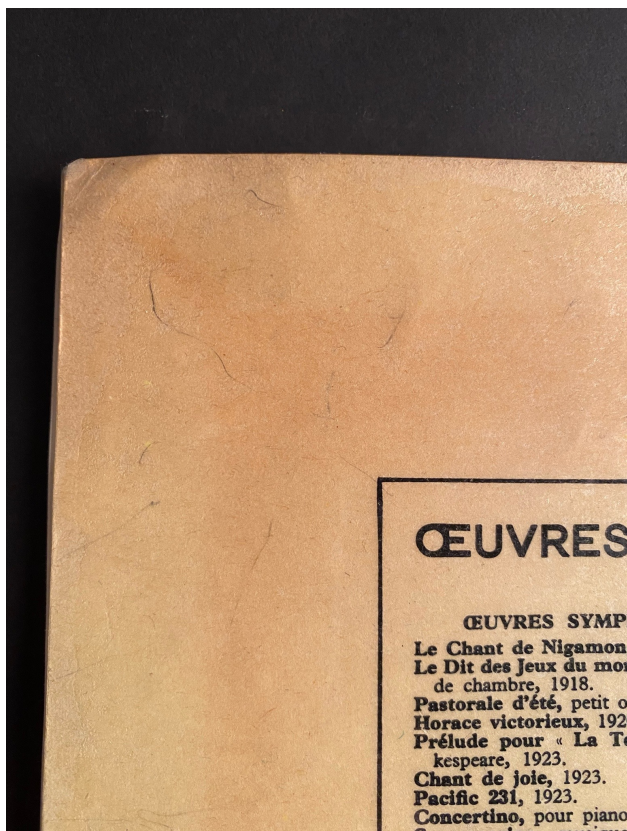
The booklet was sourced from an online auction site with no available information on its provenance. As the booklet is not considered a culturally significant object, a decision was taken to engage in experimental destructive testing. The proposed destructive testing on the booklet is designed to further the collective understanding of how PSA-laminated documents can be treated.



[Fig. 10] Stain.



[Fig. 11] Tearing.



[Fig. 12] Stains.

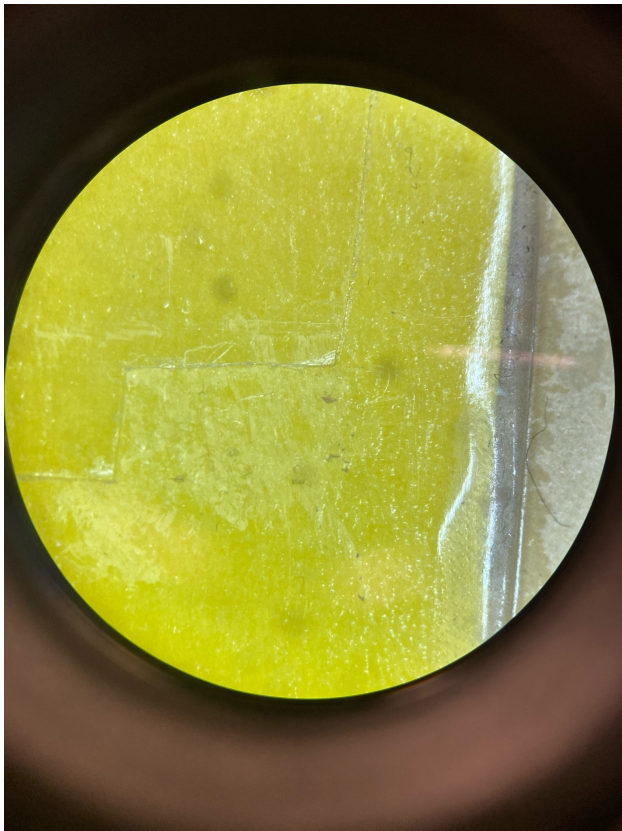


[Fig. 13] PSA-lamination.

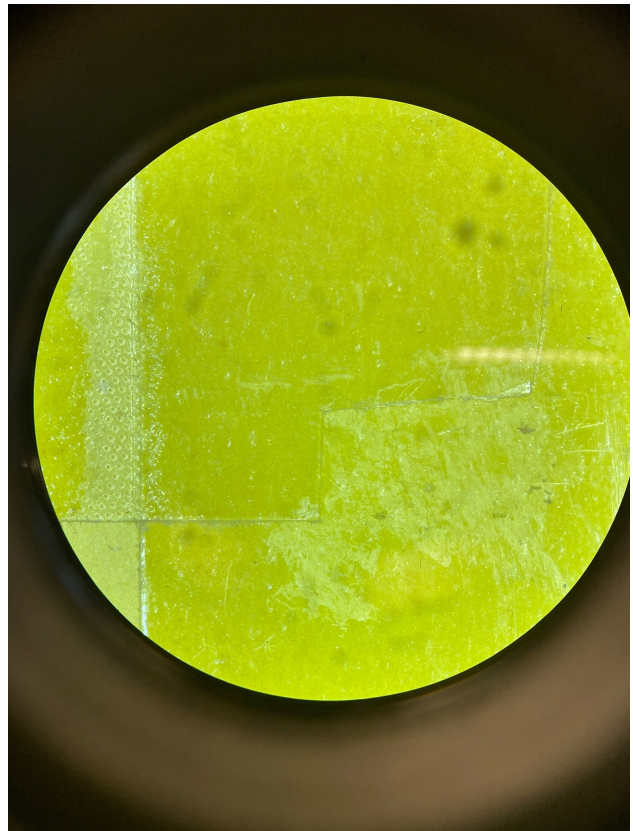
2.1.1 Material documentation

No fibre analysis to identify the paper material were conducted. With limited time to perform the experiments that makes up for this paper's objectives, the method and technique application of PST removal in the delamination of a pressure-sensitive laminated object were prioritised. However, by the appearance (yellowing fibers; 'pulpy') and the feeling of the paper (rough texture; brittle to touch), it can be presumed that the paper contains a high quantity of lignin. Consequently, the paper could consist of wood pulp, though a proper fibre analysis would be necessary to solidify this claim. The research object were observed through an optical microscope. For observational remarks, refer to Fig. 14-20.

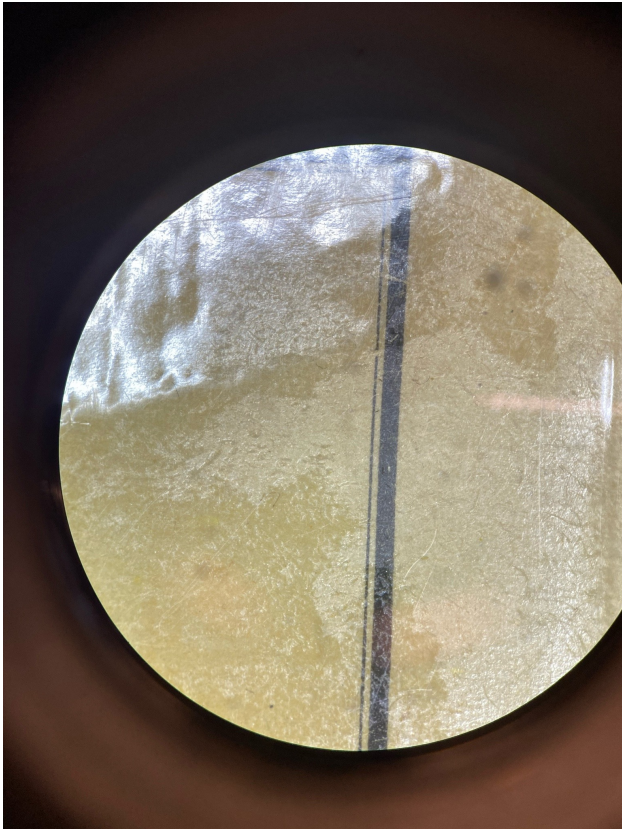
The adhesive that has been utilized in the PSA-lamination of the research object demonstrated several signs of deterioration. The adhesive mass showcased irregularity in tensile strength, possessing both qualities of softness and hardness dependent on location. The hardened adhesive mass foretell deterioration, as adhesives harden once a loss of plasticizers occurs.



[Fig. 14] Laminate cover (back page) under microscope. Planar distortion of the PSA-laminate.



[Fig. 15] Laminate cover (back page) under microscope.



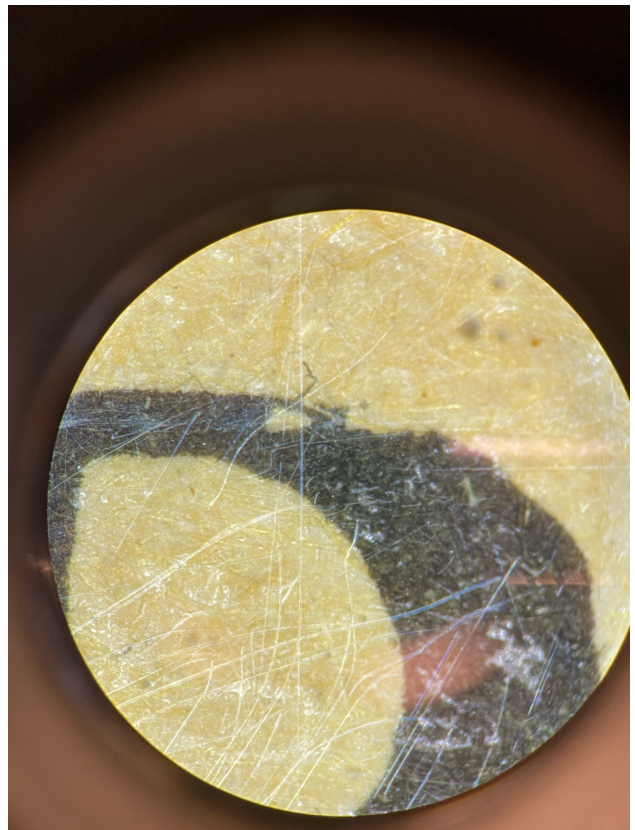
[Fig. 16] Sample under microscope. The deteriorated adhesive is detected by its darker discolouration.



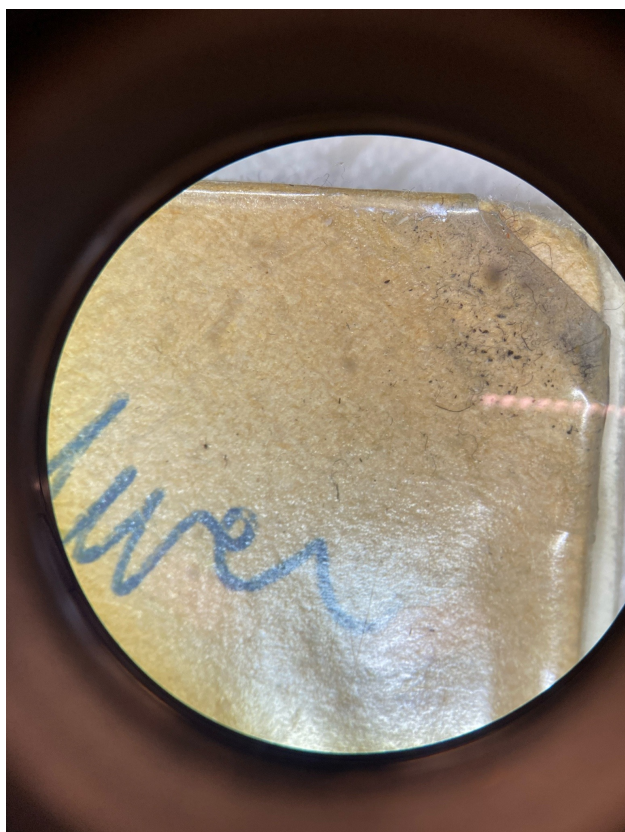
[Fig. 17] Sample under microscope.



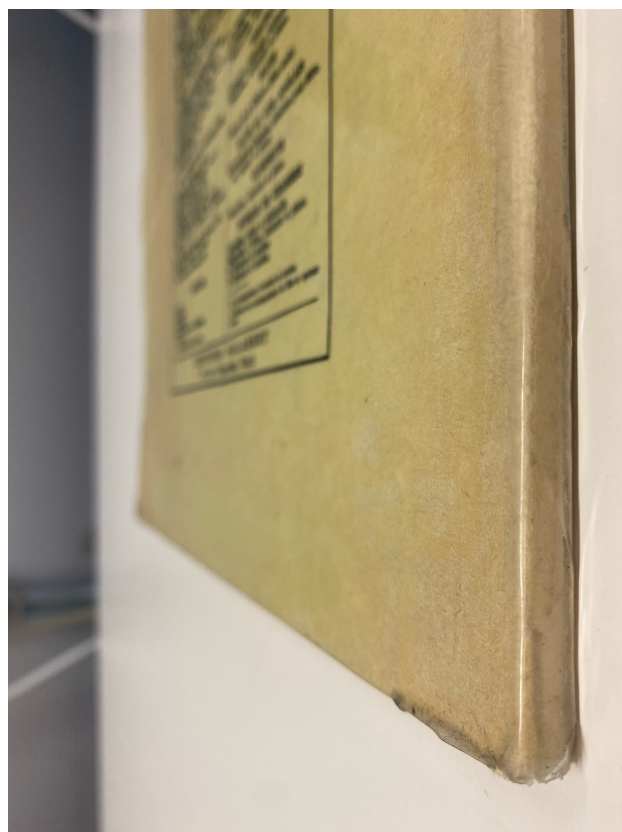
[Fig. 18] Surface medium under microscope (Leica).



[Fig. 19] Surface medium under microscope (Leica).



[Fig. 20] Dirt caught under and on PSA-laminate.



[Fig. 21] Broken binding and peeling PSA-laminate.

2.2 The research object and the ethics of destructive analysis

Destructive analysis is the term for when material has to be sacrificed in order to collect empirical data and achieve desirable results from its material data. In this case, the destructive analysis concerns the small pieces of plastic laminate that will be harvested from the research object to estimate an identification of their material through FTIR-scanning. Although small, the pieces are nonetheless material that are lost upon sampling. Hence, it is necessary to address the ethics of using destructive sampling. The destructive analysis can also be applied to the bits of the PSA-laminated cover page that will be cut off and harvested as research candidates for the application of methods and techniques of PST-removal in the conducted method experiments. Whereas the laminate shows peeling off of the booklet, there was not a possibility to harvest samples from the peeled off laminate as dirt and debris had been caught in the adhesive, which would affect the FTIR-result as the machine identifies the dirt and debris in exchange for the laminate.

As a research object, the object has not been recognised as significant for or belong to the common cultural heritage. That is, the object has not been officially acknowledged as valuable outside its potential for advancements in research. However, this does not mean that the object is not valuable. The object could have belonged to a once acclaimed person, who has been forgotten and become anonymous. The object could also have belonged to a relative of its former owner, who consequently held the object dear in love and esteem for their family. It could even be so, that its historical value is unknown, whereupon one fails to recognise its actual value and significance. There is always a story to an object, one of which might not be entirely known to the conservator that handles it. Therefore, it is appropriate and encouraged to motivate the usage of an object for research if it is used for such purposes.

The destructive analysis for the identification of the carrier and adhesive mass utilizing FTIR is founded upon the fact that the affected object has not officially been recognised as an object of cultural heritage. It is also founded upon the chance of preserving PSA-laminated objects that are recognised as objects of cultural heritage and will eventually require a decision in regards to if and how the objects are to best be preserved, where the possibility of delamination could factor in. By sacrificing the designated research object for the purpose of this paper, there is a potential that the conservation-preservation of PSA-laminated objects will receive support from the results and allow greater chance to further their chance at longevity.

2.3 What is researched

An experiment was designed to test a range of delamination methods for documents laminated with pressure-sensitive adhesive laminate tissue. The relative success of each of the delamination approaches was empirically assessed according to the criteria outlined below:

- Appearance of paper surface
- Legibility of text
- Extent of removal of the modified polymer lamination
- Extent of removal of the laminate adhesive
- Surface abrasion
- Planar distortion of the paper surface
- Retainment of ink medium
- Treatment time required
- Resources required to perform the respective techniques and methods
- Environmental impact of materials used
- Potential impact on the health and safety of the practitioner when utilizing the respective techniques and methods
- Tidelines/discolouration
- An overall score on the ease of the delamination procedure.
- An overall score on the success of the delamination procedure.

2.4 Experimental methods

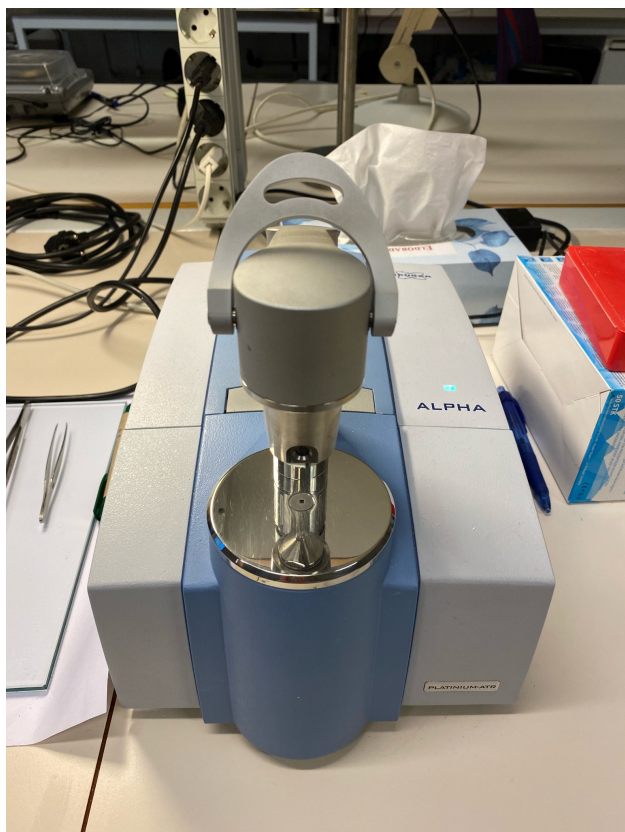
Documentation

Documentation is a vital component of conservation treatment and the neglect of documenting an object compromises its chance of being preserved (as an object is a result of its time, both by in which condition it is, in what environment it has been, and how it may or may not have been previously treated by conservators). To illustrate, an object in need of active conservation measures has undergone prior conservation treatment which is incompatible with the measure that is being considered or proposed today. Thus, it is credible to regard it being the conservator's responsibility and interest of preserving cultural heritage to not merely document the object as is, but also as it has become since it underwent treatment by said conservator. This will benefit contemporary and future conservators, as it can support their consideration of appropriate treatments and in their exclusion of arguably inappropriate ones. With this said, there is a benefit to describe and explain what documentation really means and entails in the context of conservation.

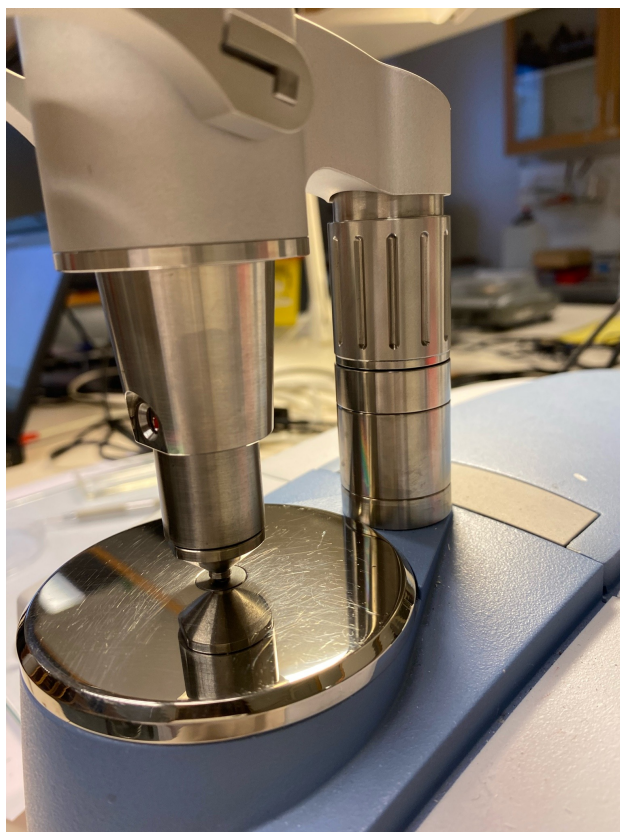
Fourier-transform infrared spectroscopy (FTIR)

Fourier-transform infrared spectroscopy, abbreviated FTIR, is a spectroscopical-analytical tool that can be employed to characterise the molecular composition of an unknown material. The interaction of electromagnetic infrared radiation with a sample of the unknown material produces a characteristic absorbance spectrum, with peaks at specific wavelengths indicative of the material's molecular structure. Through a combined process of identifying and characterising the molecular constituents of the material and comparing the spectrum of the material to that of other known reference materials, the unknown material can be estimated and possibly identified.

While FTIR is not considered an inherently destructive technique, often very small samples are crushed when using the ATR accessory. When this analysis method does require such a destructive sample, it consequently requires the conservator to resolve whether or not the method is appropriate and justifiable regarding the intention to preserve an object. Furthermore, FTIR-analysis does not capture the entirety of the object's material, but rather provides a localized result in relation to where the sample was collected. Consequently, results may vary with one sample presenting some chemical components of certain concentrations, whereas another sample could present other chemical components or the same but with concentrations divergent from the previous. With this in mind, it is necessary to regard the uncertain parameters that FTIR-analysis operate within and take them into account when interpreting the results.



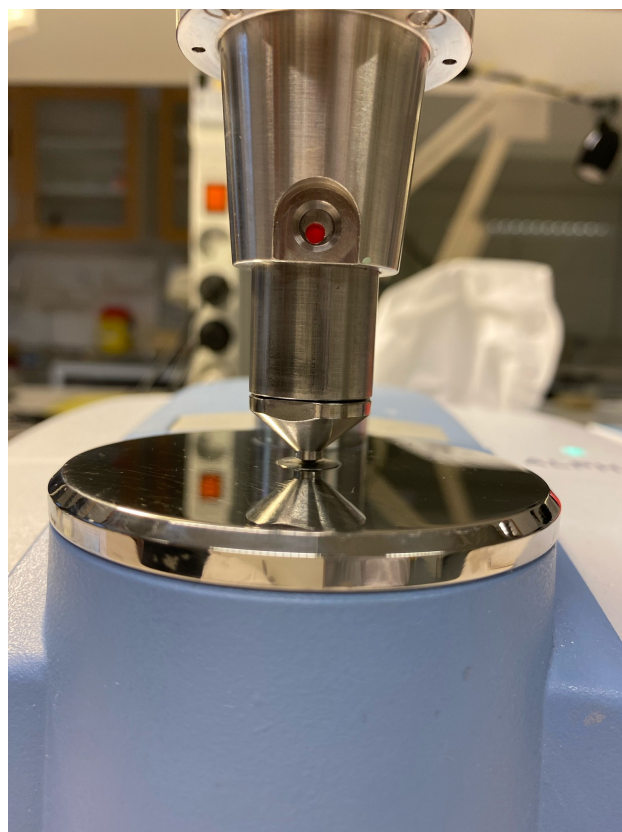
[Fig. 22] The ALPHA FTIR-scanner that were utilized in this paper.



[Fig. 23] Anatomy of the FTIR-scanner: (1) disk, (2) mouthpiece, (3) lever.



[Fig. 24] Sample 1 (left) and Sample 2 (right).



[Fig. 25] Adjusted and calibrated FTIR-scanner, ready for analysis. The sample lies right underneath the mouthpiece of the scanner.

To calibrate the FTIR-scanner, there is an initial background check in which the FTIR-scanner measures the materials in the surrounding atmosphere. This takes a couple of seconds to around a minute. Once checked, the FTIR-scanner is then turned on. When it emits a beep, power is confirmed. The FTIR-scanner is best to sanitize before and after use, as to prevent contamination in the material results.

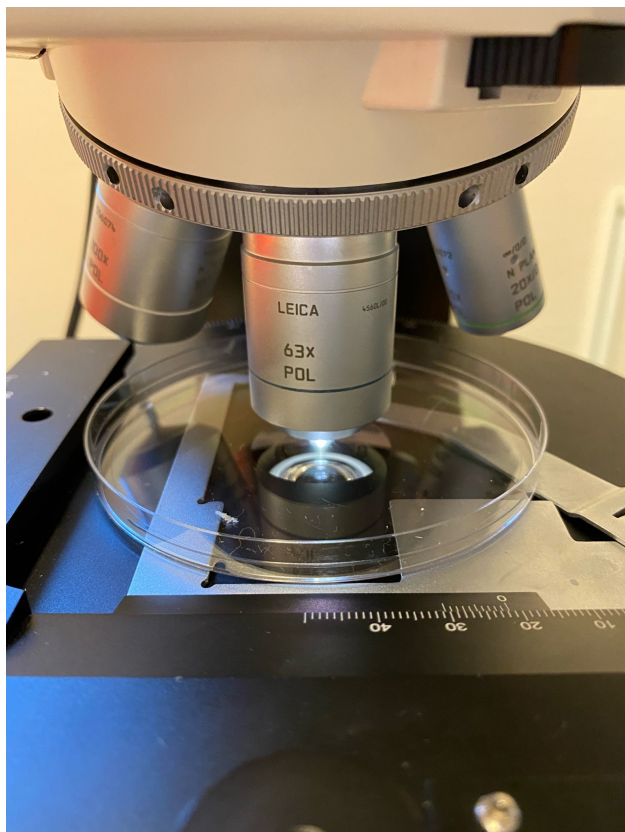
In OPUS, the tool of 'advanced measurements' is opened. There, a 'background single channel' is chosen. It is important that the lever and the mouthpiece it connects to is not down when the background single channel is chosen. Then, advanced measurements is re-opened. Thereafter it is set to (1) advance (2) path (3) sample single channel (4) start channel, and (5) single peak pick. Then, the FTIR-scanner is ready to analyze the material.

It is best to use gloves when placing the sample on the FTIR-scanner disc, as the natural fats and debris on the hands can confuse the FTIR-scanner and illegitimize the results.

Optical microscopy

Microscopy concerns the usage of microscopes to study and examine what is not visible to the naked eye. In optical microscopy, the optical microscope provides a magnified view of the researched materia by the transmit of visible light through the microscope's singular or multiple lenses. Today, optical microscopes may feature a digital camera where the macro image is captured, saved, and presented. However, the optical microscope used for this paper did not possess a digital camera. Thus, all images

from the conducted optical microscopy have been taken manually with an exterior camera lens by the author.



[Fig. 26] Leica Microscope utilized in this paper for thorough and very close microscopical observation. The sample lies on a plastic dish.



[Fig. 27] Leica microscope that were utilized in this paper form less thorough analysis and observation under microscope. The sample were placed on a dish, with a protective sheet underneath the dish as well as height adjustment.

Techniques and methods associated with the removal of pressure-sensitive tape

Mechanical removal

As the name suggests, mechanical removal is to remove something with tools. Mechanical removal is a dry technique and method, as it does not involve (but can be combined with) solvents or thermal aggregates such as heat or cold.

Direct solvent application

Direct solvent application involves a solvent of choice that is directly applied onto the materia that the solvent is intended to dissolve. The application can, and is often, combined with mechanical removal. For example, the mechanical removal could consist of the rubbing with a cotton swab that has been saturated with the solvent of choice.

Solvent chamber, also known as the 'bottle trick'

The 'Bottle Trick' or a solvent chamber describes an indirect solvent application where the fumes from the solvent is the solves the material rather than that of the liquid in and of itself. To create a solvent chamber, only a beaker or vessel of an appropriate size to the object, cotton

wool, solvent of choice, and pipette is required. Naturally, a refined manufacture may be preferred when utilizing the solvent chamber for large, heavy, or otherwise difficult objects.

Stuffing the beaker or vessel with cotton wool at its bottom, the solvent of choice is pipetted onto the cotton wool until damp but not dripping or wet. Then, the beaker is simply turned upside down and placed on top of or over the tape or laminated object that is to be delaminated. The theory goes, that the fumes from the solvent will weaken the bonds of the adhesive mass and primer, upon which the tape or lamination can be mechanically removed off of the surface. At its most successful rate, little to no force is necessary to mechanically discard the tape or lamination; a light-handed peel is satisfactory, if not the tape or lamination peels itself off without the conservator applying physical force.

Local heat removal

Heat have the thermal ability to soften adhesive as seen in the demonstration of their melting glass temperature. Local heat removal involves, as the name suggests, a localized heat application. This means that the applied heat is confined to the restricted area of the application tool. A local heat removal may involve using a metal spatula that is heated up and then applied onto the surface of a piece of the object.

Overall heat removal

Overall heat removal, on the other hand, involves an application of heat that covers the total area of the object's surface area. For example, using a hot plate to heat up the side of a paper document would fall under the treatment category of overall heat removal.

Teas graph chart

Teas graph chart is a tool common for conservators to use when estimating the solubility of solvents for a specific material. The Teas graph chart was constructed from three known component forces, dispersion force; polar force; and hydrogen bonding force, combining them to a single planar graph. It is an empirical system that adheres to the hypothesis that the Hildebrand value is the same for all materials. By this hypothetical assumption, it is not the Hildebrand value that determines the solubility characteristics and behaviour of a solvent. Rather, it is the three component forces aforementioned, which all contribute to the total Hildebrand value.

By utilizing the Teas graph chart, an estimated solvent can be chosen to dissolve a material that is wished to be removed, while sparing a material that is wished to be kept intact. An example of this would be to utilize the Teas graph chart to estimate a solvent that will dissolve the adhesive from removed tape on paper, but not dissolve the written ink medium beneath the adhesive material.

Below is an illustration of the Teas graph chart which illustrates the relationship between the three component forces, as well as the location of different solvents on the graph correlated to group and type.

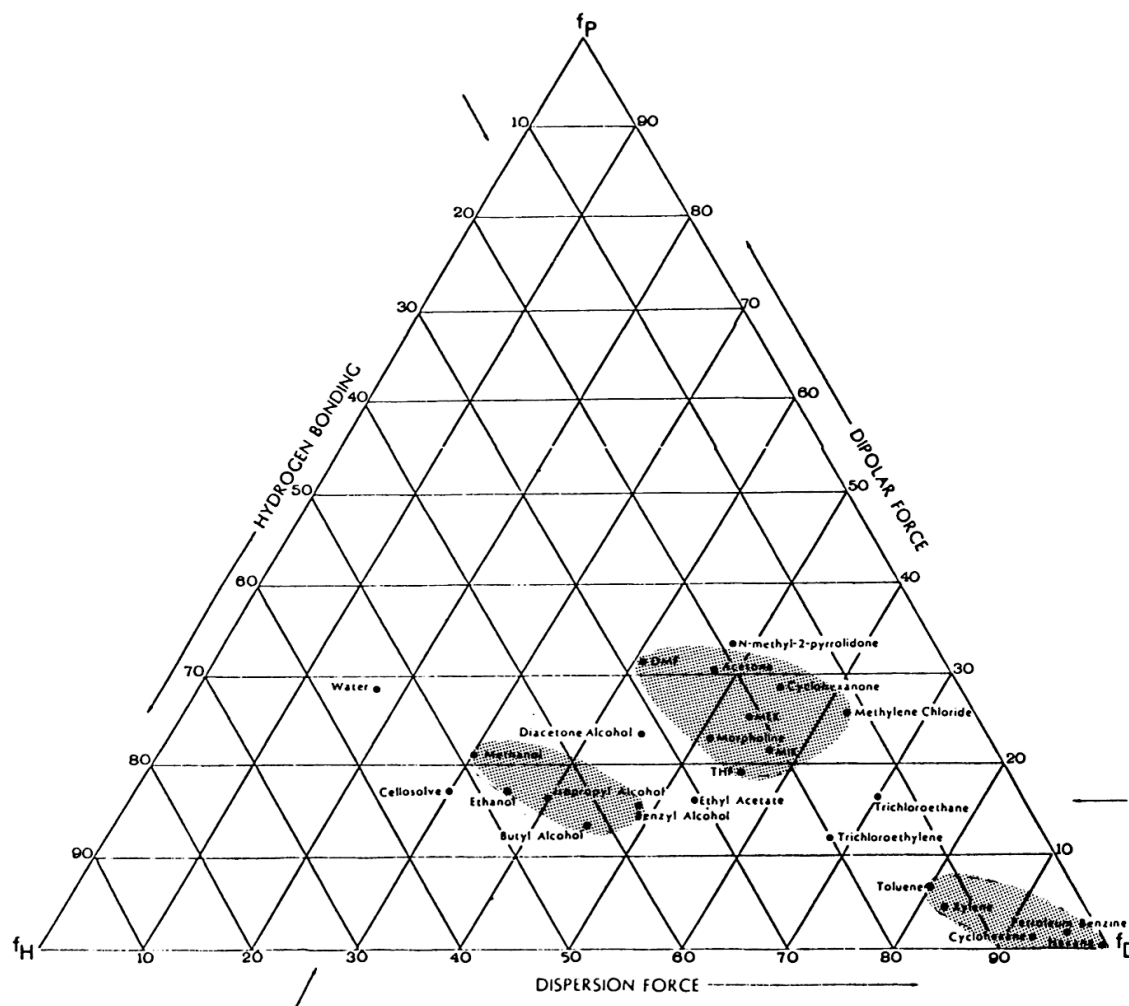


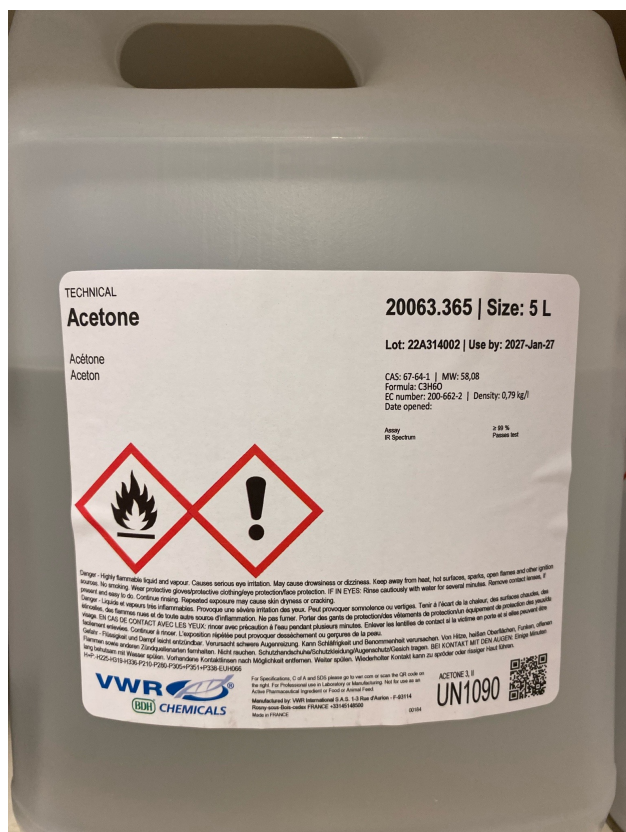
Fig. 2. Plot on Teas chart of fractional solubility parameters of many solvents used in paper conservation. Shaded areas depict ranges of solubility associated with alcohols, ketones, and hydrocarbons.

[Fig. 28] Tea's graph chart. From *Pressure-Sensitive Tape and Techniques for Its Removal From Paper* (Smith et al 1984, 105).

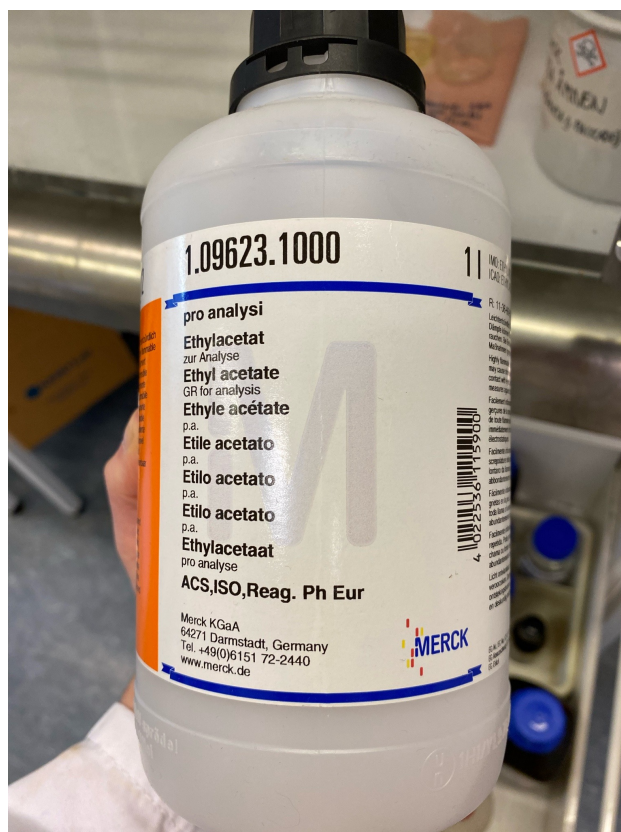
However, as the Hildebrand values are not the same for all liquids, it is important to remember that although the Teas chart graph has proved to be a useful and accurate tool for conservators to utilize in their practice, it nonetheless lacks a theoretical foundation as of yet. And while it is advocated by conservators practitioners as easy to understand and use, not all conservators agree. For example, Stavroudis and Blank (1989) criticize the tool, so far as to advising a campaign to ban it. They justify their stance, explaining "The three solubility parameters are not that accurate, although they are among the best predictors we have. Compressing the parameters onto a triangular diagram makes matters worse." They reference to Barton (1983), who reportedly wrote in the *CRC Handbook of Solubility Parameters and Other Cohesion Parameters* that the values of Teas graph chart have "the disadvantage that they are completely empirical, without even the limited theoretical justification of Hansen's three-component parameters." Stavroudis and Blank continued their justification with that "in the Teas

diagram, the range of solubilities of a polymer is distorted into an odd shape, some relations between solvents are lost' (1989).

The solvents utilized in this paper for the direct solvent application and the respective poultice chambers are acetone (C_3H_6O) by VWR and ethyl acetate ($C_4H_8O_2$) by MERCK. The solvents were chosen in accordance with the rule that like-dissolves-like. That is, that organic solvents will dissolve organic material, and inorganic solvents will dissolve inorganic material. Both acetone and ethyl acetate are organic solvents, with acetone being a (dimethyl) ketone and ethyl acetate being an (acetic) ester.



[Fig. 29] Acetone by VWR utilized in this paper.



[Fig. 30] Ethyl acetate by MERCK utilized in this paper.

The molecule of a ketone consists of a carbonyl group bonded to carbons. The molecule of an ester, however, has both a carbonyl group and alkoxy group that are bonded together. The carbon atoms in a ketone share a covalent bond to oxygen atoms. It is this bond, that creates the carbonyl group, to which the carbons then bond to. In an ester, however, the alkoxy (an oxygen atom and an alkyl) group replaces the hydroxyl group and accompanies the carbonyl group within the molecule.

Hence, an ester is a less acidic molecule because of the presence of the alkoxy group, whereas a ketone is a more acidic. They are both polar solvents, with acetone having a polarity index of 5.1, and ethyl acetate a polarity index of 4.4. As suggested by the polarity indexes, the polar nature of the carbonyl group increases the reactivity of ketones and provides the molecule with a partial positive charge. As it has been established that esters do not possess a carbonyl group, esters are less reactive than ketones are and not as charged. In other words, ethyl acetate is polar, but less so than acetone is.

As with all instances when mixing chemicals, it is of greatest concern to become aware of potential risks of mixing said chemicals before one attempts to mix these. Attached in the appendix on p. 65, are the respective risk assessments for acetone and ethyl acetate.

2.5 Experimental design

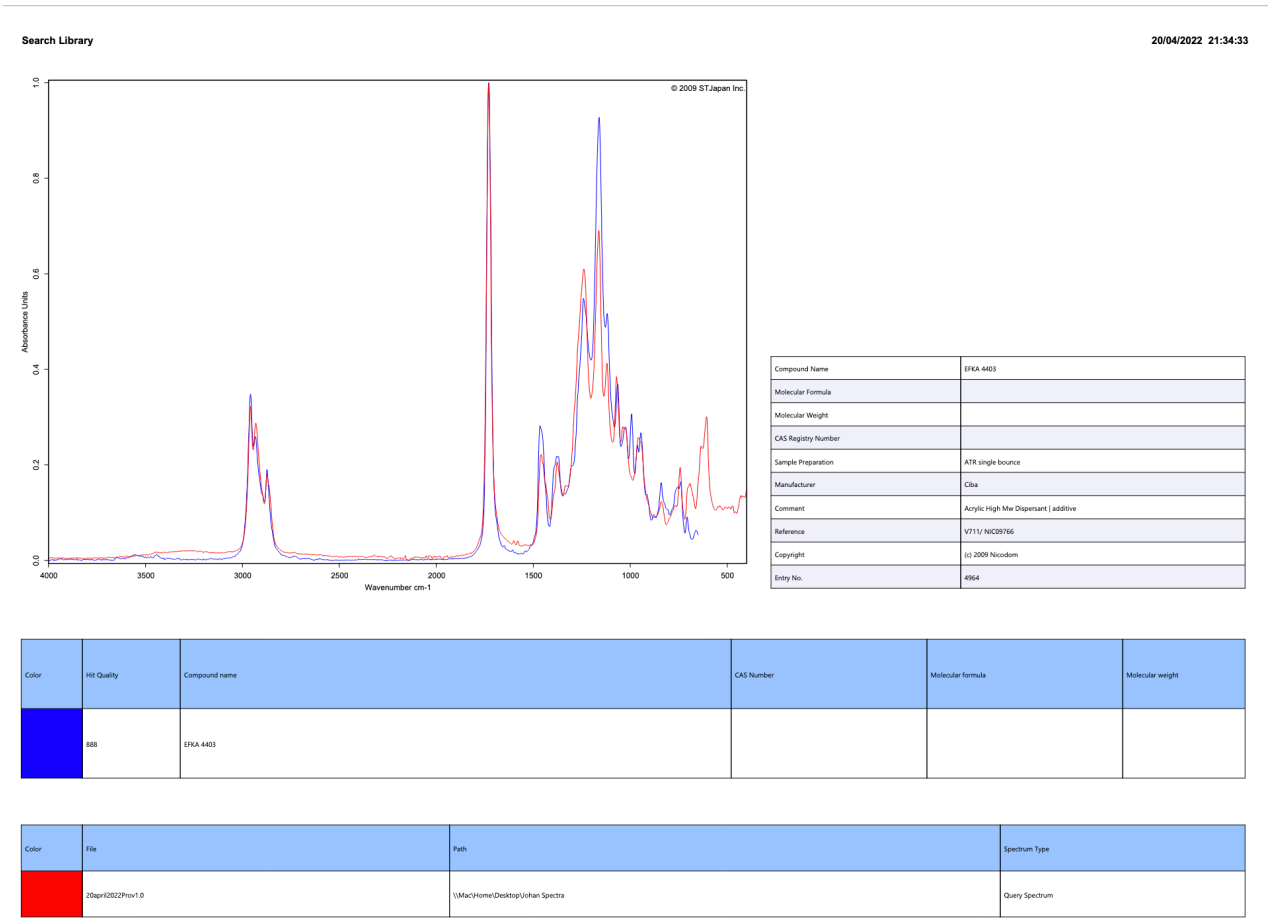
In the experimental design a range of delamination methods and techniques proposed for the removal of PSTs as described in AIC wiki were chosen and conducted. The chosen and conducted methods and techniques were assessed in their appropriateness for the delamination of PSA-laminations according to parameters based on principles within conservation-preservation theory and practice.

3. Results

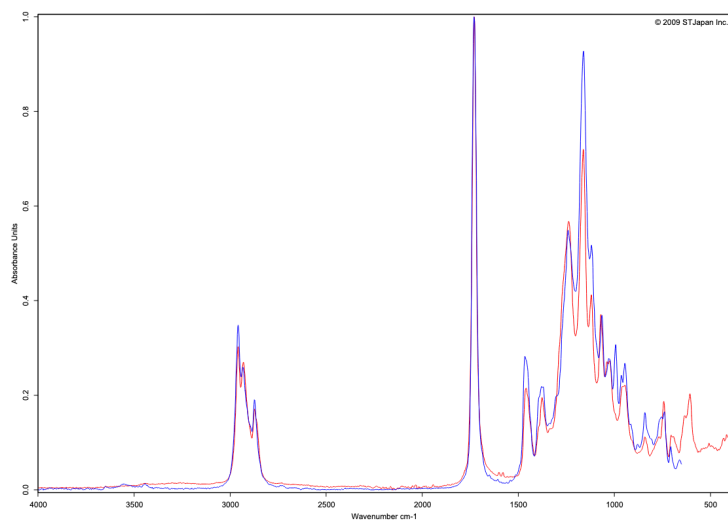
3.1 FTIR-scan analysis

Both samples were run once in the FTIR-scan, providing two separate graphs. Because the two samples were harvested from the object by the same region, the two graphs could operate references material in comparison of the retrieved results and aid in determining if the results of either two are faithful.

3.1.1 Identification of the PSA-lamination’s plastic material by FTIR-scan analysis



[Fig. 31] Plastic film sample 1.



Compound Name	EFKA 4403
Molecular Formula	
Molecular Weight	
CAS Registry Number	
Sample Preparation	ATR single bounce
Manufacturer	Ciba
Comment	Acrylic High Mw Dispersant (additive)
Reference	V711/ NC09766
Copyright	(c) 2009 Nicotom
Entry No.	4964

Color	Hit Quality	Compound name	CAS Number	Molecular formula	Molecular weight
Blue	915	EFKA 4403			

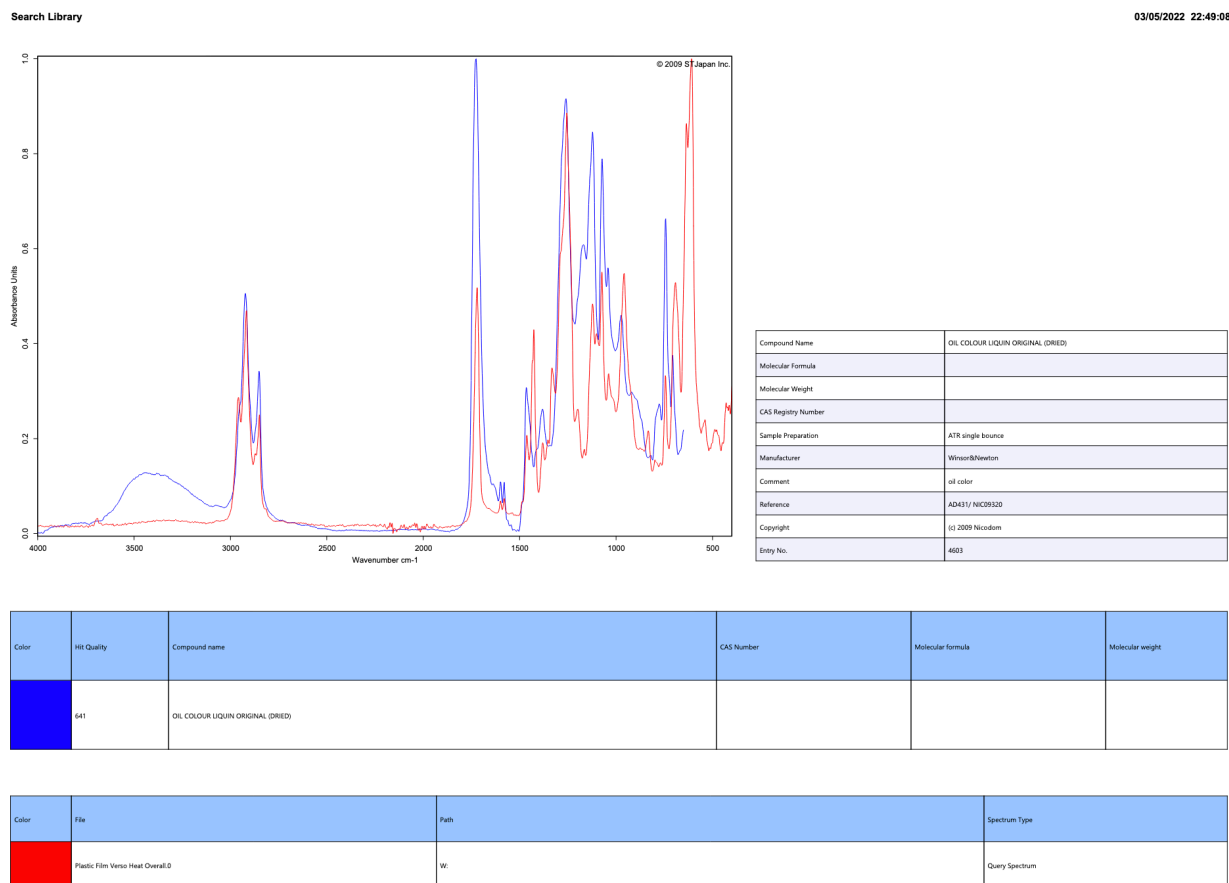
Color	File	Path	Spectrum Type
Red	20Apr12022Phon2.D	\\Mac\Home\Desktop\Ushan Spectra	Query Spectrum

[Fig. 32] Plastic film sample 2.

Both samples were harvested from an adjacent location and were identified as EFKA 4403. EFKA 4403 is a modified polyacrylate, used in pigment concentrates. Please refer to appendix listed on p. 65.

3.1.2 Identification of the PSA-lamination's adhesive material by FTIR-scan analysis

A FTIR-analysis of the adhesive was also conducted on the pieces of plastic that had been delaminated. The selection among the pieces were based on the amount of residual adhesive of each piece. The piece with most adhesive residue, became the selected sample for this analysis. In the graph below, the result from the FTIR-scan is presented.

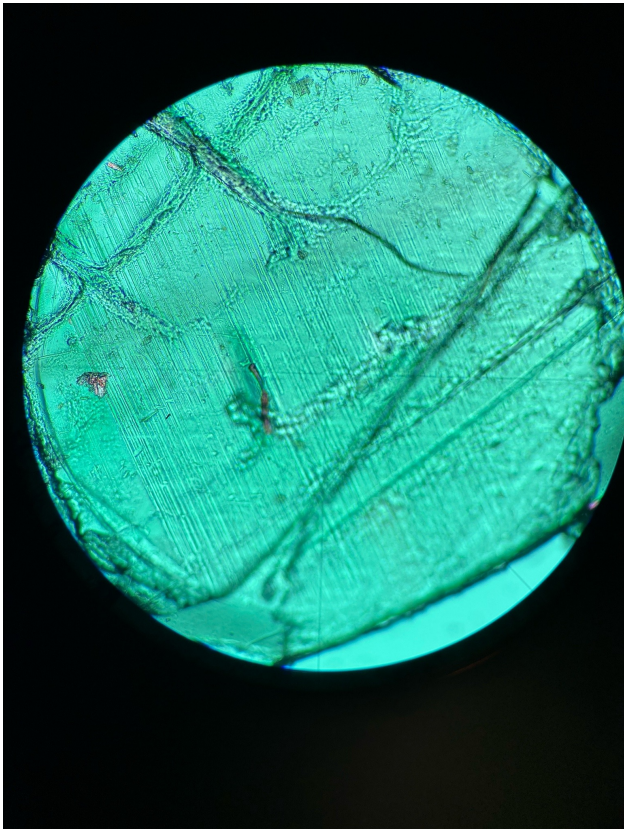


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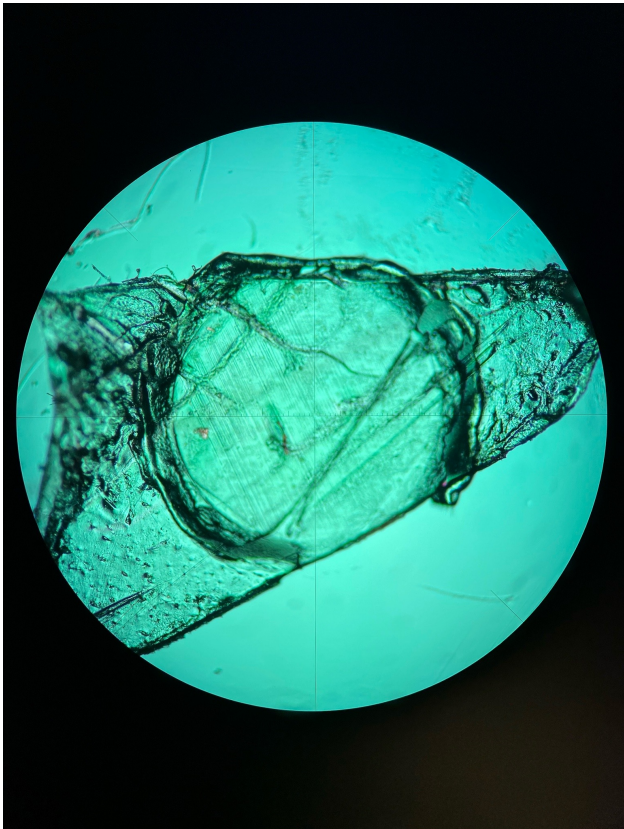
[Fig. 33] Adhesive sample.

Through comparison with the material library database, the closest match to the peaks of the sample was 'OIL COLOUR LIQUIN ORIGINAL (DRIED)' at a hit of 641 in accuracy. Liquin is an alkyd resin. As an alkyd resin, the liquin is believed to have been utilized as a curing agent of the adhesive. Thus, the scan of the adhesive came out unsuccessful in the identification of the adhesive as a whole. The adhesive or bonding agent of the adhesive also remains unknown. Listed in the appendix on p. 65, is the product information of the reference liquin material.

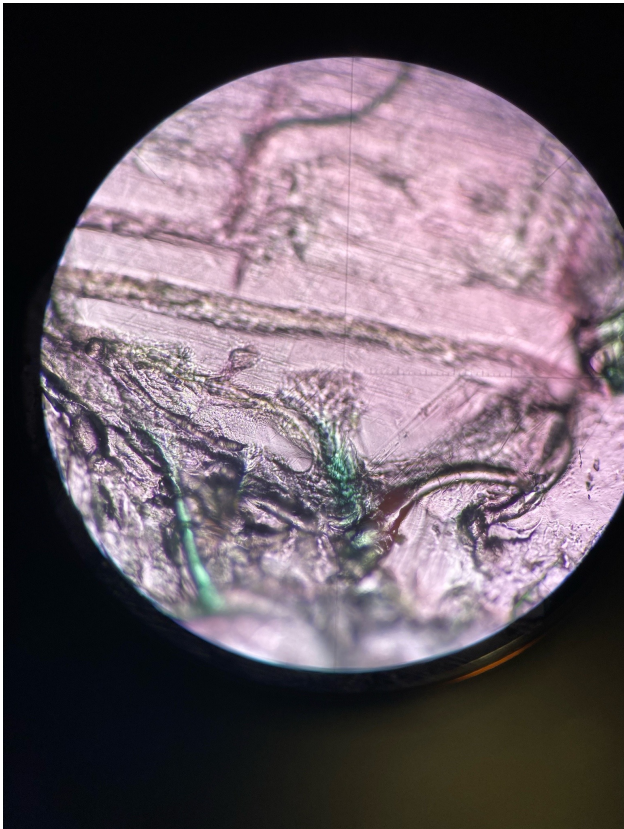
3.2 Microscopy



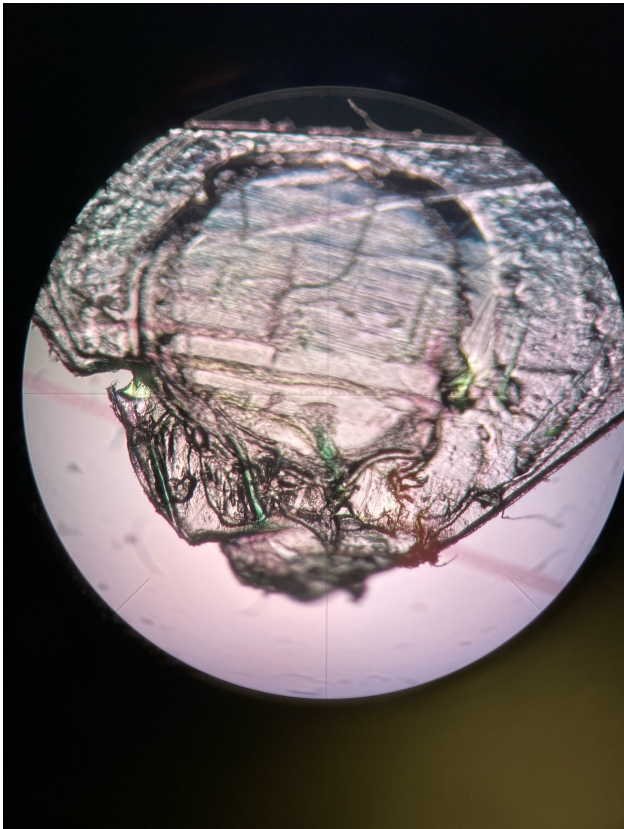
[Fig. 34] Sample 1, under microscope.



[Fig. 35] Sample 1, under microscope.



[Fig. 36] Sample 2 under microscope.



[Fig. 37] Sample 2 under microscope.

3.3 Conducted experiments of methods of removal of PSTs on PSA-laminated paper

Cotton poultice chamber

Cotton, beaker, pipette, fume hood box, nitrile gloves, scalpel

1. Acetone
2. Ethyl acetate

1) A beaker of appropriate size to the sample was cleaned and dried. Then, cotton was added to the beaker, filling out the space until full. The beaker was subsequently signed with its content ((1) acetone/(2) ethyl acetate), user (undersigned) and date. The beaker and sample were then moved to within a fume box.

2) Using a pipette, 5 drops of (1) acetone/(2) ethyl acetate was added onto the cotton. Then, the beaker was placed upside-down on top of the sample, with its bottom facing up. This way the cotton-(1) acetone/(2)ethyl acetate came in contact with the sample.

3) The sample were checked every 10 minutes. By each 10 minutes, another 5 drops of (1) acetone/(2) ethyl acetate were added as done before. There were four checks in total, meaning there was a total of 20 drops of (1) acetone/(2) ethyl acetate pipetted onto the cotton in the beaker.

4) When 50 minutes had gone (40 min active chamber + 10 waiting time after last pipette), the sample was taken out of the fume box and beaker. The sample was then placed on top of a regular working table, where the plastic film and adhesive were mechanically removed with a scalpel. The scalpel was held pressed against the thumb, as to allow as much flat as of angle as possible. When allowed, the blunt ridge of the scalpel blade was used to mechanically remove the plastic film and adhesive instead of its blade. When possible, the scalpel were substituted with a bamboo stick, removing the adhesive and plastic film in soft, rolling motions.

Mechanical removal

Scalpel, bamboo stick

1) The sample were put on a regular working table dressed in vlieseline to protect the sample from residues of dust or dirt. The vlieseline also became helpful in catching the removed bits of plastic film, due to the vlieseline's texture.

2) The scalpel was held pressed against the thumb, as to allow as much flat as of angle as possible. When allowed, the blunt ridge of the scalpel blade was used to mechanically remove the plastic film and adhesive instead of its blade. When possible, the scalpel were substituted with a bamboo stick, removing the adhesive and plastic film in soft, rolling motions.

(Remarks)

Local heat removal

Heat spatula, vlieseline, scalpel

- 1) The sample were put on a regular working table dressed in vlieseline to protect the sample from residues of dust or dirt. The vlieseline also became helpful in catching the removed bits of plastic film, due to the vlieseline's texture.
- 2) Another sheet of vlieseline, cut square with measurements proportioned to the sample with an additional 1 cm border, was put on top of the sample. Then, the heat spatula was turned on and left to warm up under supervision. Once reaching a temperature of 40 Celsius degrees, the heat spatula was applied onto the vlieseline that covered the sample.
- 3) The heat spatula was applied in successions, under a slight small rotating motion. The heat was turned up to x degrees, when shown that the previous heat did not demonstrate any signs of burning the sample, but also did not display much of a successful result in removing the plastic film and adhesive. The previous and aforementioned technique of application and motion were repeated until the amount of removed plastic film and adhesive was found satisfactory. At most, the heat spatula was set to 60 Celsius degrees during this experiment.
- 4) After an accepted amount of plastic film and adhesive had been thermally removed, the heat spatula was turned off. The vlieseline on top of the sample were also removed. The residual plastic and film adhesive were then manually removed. The scalpel was held pressed against the thumb, as to allow as much flat as of angle as possible. When allowed, the blunt ridge of the scalpel blade was used to mechanically remove the plastic film and adhesive instead of its blade. When possible, the scalpel were substituted with a bamboo stick, removing the adhesive and plastic film in soft, rolling motions.

Overall heat removal

Heating stove, vlieseline, scalpel

- 1) A stove, with a protective vlieseline cover on its coil, were turned on and set to 40 Celsius degrees. Once the temperature had been reached, the sample were put on top of the vlieseline and observed under supervision.
- 2) The heat was turned up to x degrees, when shown that the previous heat did not demonstrate any signs of burning the sample, but also did not display much of a successful result in removing the plastic film and adhesive. At most, the heat spatula was set to 60 celsius degrees during this experiment.
- 3) After an accepted amount of plastic film and adhesive had been thermally removed, the sample were removed off of the stove and onto a working table. Sequentially, the stove was turned off.
- 4) A scalpel to remove the remnants of plastic film and adhesive were then utilized. The scalpel was held pressed against the thumb, as to allow as much flat as of angle as possible. When allowed, the blunt ridge of the scalpel blade was used to mechanically remove the plastic film and adhesive instead of its blade. When possible, the scalpel were substituted with a bamboo stick, removing the adhesive and plastic film in soft, rolling motions.

Direct solvent application

Cotton swab (cotton + bamboo stick), scalpel, beaker, gore film, fume hood box, nitrile gloves

1. Acetone
2. Ethyl acetate

1) The sample were put in a fume box with a protective paper sheet underneath. A beaker was then prepared by cleaning it in the sink before bringing it into the fume box. Once in the fume box, 50ml of (1) acetone/(2) ethyl acetate were added to the beaker. The beaker was subsequently signed with its content ((1) acetone/(2) ethyl acetate), user (undersigned) and date.

2) The (1) acetone/(2) ethyl acetate were then applied onto the laminate with a cotton swab. The cotton swab was saturated with the solvent, but not to the point of over-saturation (the solvent dripping off the cotton swab when moving and turning). When applied to the laminate, the saturated cotton swab was motioned in gentle circular motions.

3) When the laminate demonstrated signs of planar distortion and shrinkage from its contact with the solvent and the mechanical affect of its application, the sample was taken out of the fume box and put on a regular working table. Gore film was put on the beakers to elongate their life in case of further usage.

4) A scalpel to remove the remnants of plastic film and adhesive were then utilized. The scalpel was held pressed against the thumb, as to allow as much flat as of angle as possible. When allowed, the blunt ridge of the scalpel blade was used to mechanically remove the plastic film and adhesive instead of its blade. When possible, the scalpel were substituted with a bamboo stick, removing the adhesive and plastic film in soft, rolling motions.

Acetone solvent chamber

Cotton, beaker, pipette, fume hood box, nitrile gloves

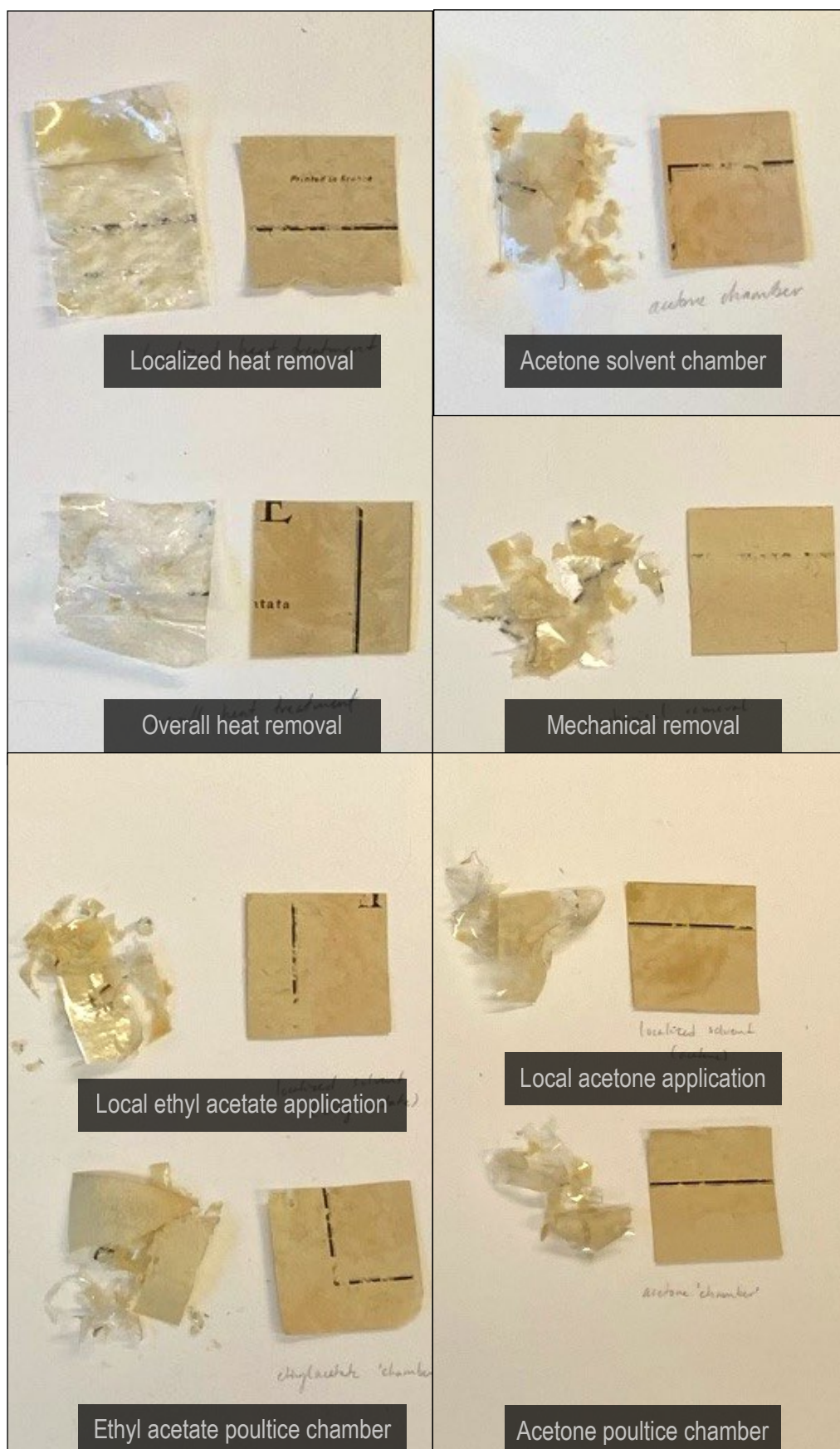
- 1) A beaker of appropriate size to the sample was cleaned, dried and signed with its content (acetone), user (undersigned) and date. Then, cotton was added to the beaker, pushed to the bottom of the beaker until fully set and not gliding down when held upside-down. The beaker and sample were then moved to within a fume box.
- 2) Using a pipette, 10 drops of (1) acetone/(2) ethyl acetate was added onto the cotton. Then, the beaker was placed upside-down on top of the sample, with its bottom facing up. This way the vapor or gas from the cotton-(1) acetone/(2) ethyl acetate came in contact with the sample, but not initiate direct contact.
- 3) The sample were checked every 10 minutes. By each 10 minutes, another 10 drops of (1) acetone/(2) ethyl acetate were added as done before. There were four checks in total, meaning there was a total of 50 drops of (1) acetone/(2) ethyl acetate pipetted onto the cotton in the beaker.
- 4) When 50 minutes had gone, the sample was taken out of the fume box and beaker. The sample was then placed on top of a regular working table, where the plastic film and adhesive were mechanically removed with a scalpel. The scalpel was held pressed against the thumb, as to allow as much flat as of angle as possible. When allowed, the blunt ridge of the scalpel blade was used to mechanically remove the plastic film and adhesive instead of its blade.

	Cotton poultice chamber 1. Acetone 2. Ethyl acetate	Mechanical removal with scalpel	Local heat removal (48-60 celsius)	Overall heat removal	Direct solvent application 1. Acetone 2. Ethyl acetate	Solvent acetone chamber
Appearance of paper surface	1. Acceptable 2. Poor	Very, very poor	Very poor	Acceptable	1. Very poor 2. Very poor	Very poor
Legibility of ink medium	1. Acceptable 2. Bad	Very, very poor	Poor	Good	1. Poor 2. Very poor	Very poor
Extent of removal of the modified polymer lamination	1. Good 2. Good	Good	Good	Very good	1. Good 2. Good	Good
Extent of removal of the laminate adhesive	1. Good 2. Good	Good	Poor	Very poor	1. Good 2. Good	Poor
Surface abrasion	1. Bad 2. Severe	Severe	Severe	Acceptable	1. Bad 2. Bad	Bad
Planar distorsion of the paper surface	1. Bad 2. Acceptable	Minimal	Bad	Acceptable	1. Bad 2. Minimal	Minimal
Retainment of ink medium	1. Very poor 2. Poor	Very, very poor	Poor	Poor, but better than local heat	1. Poor 2. Poor	Poor
Treatment time required (minutes)	1. 40 min + 40 min — > 80 min 5 pipettes/10 min (Acetone) 2. 40 min + 40 min — > 80 min 5 pipettes/10 min (Ethyl acetate)	50 minutes	105 minutes	60 min (on stove) + 15 min (removal) +	1. 40 minutes 2. 2. 55 min	140 min

	Cotton poultice chamber 1. Acetone 2. Ethyl acetate	Mechanical removal with scalpel	Local heat removal (48-60 celsius)	Overall heat removal	Direct solvent application 1. Acetone 2. Ethyl acetate	Solvent acetone chamber
Environmental impact of materials used	<p>The disposal of ethyl acetate (2) is regulated as hazardous waste and therefore chemical waste should be practiced. Chemical waste disposal of acetone (1) is also advised.</p> <p>The saturated cotton is to be disposed in an appropriate, dry chemical waste bin.</p> <p>If a plastic pipette is used, repeated usage is typically not practiced. Plastic pipettes therefore require disposal after its single usage. Disposal that allows for plastic recycling is advisable.</p> <p>Determining how to dispose of the removed laminate is advisable.</p>	<p>The method does not utilize solvents that require chemical waste.</p> <p>The scalpel allows for repeated and further use if handled and maintained correctly.</p> <p>Determining how to dispose of the removed laminate is advisable.</p>	<p>The heat spatula allows for repeated and further use if handled and maintained correctly.</p> <p>Determining how to dispose of the removed laminate is advisable.</p>	<p>The stove allows for repeated and further use if handled and maintained correctly.</p> <p>Determining how to dispose of the removed laminate is advisable.</p>	<p>The disposal of ethyl acetate (2) is regulated as hazardous waste and therefore chemical waste should be practiced. Chemical waste disposal of acetone (1) is also advised.</p> <p>The saturated cotton is to be disposed in an appropriate, dry chemical waste bin.</p> <p>If a plastic pipette is used, repeated usage is typically not practiced. Plastic pipettes therefore require disposal after its single usage. Disposal that allows for plastic recycling is advisable.</p> <p>Determining how to dispose of the removed laminate is advisable.</p>	<p>Chemical waste disposal of acetone (1) is advised.</p> <p>The saturated cotton is to be disposed in an appropriate, dry chemical waste bin.</p> <p>If a plastic pipette is used, repeated usage is typically not practiced. Plastic pipettes therefore require disposal after its single usage. Disposal that allows for plastic recycling is advisable.</p> <p>Determining how to dispose of the removed laminate is advisable.</p>

	Cotton poultice chamber 1. Acetone 2. Ethyl acetate	Mechanical removal with scalpel	Local heat removal (48-60 celsius)	Overall heat removal	Direct solvent application 1. Acetone 2. Ethyl acetate	Solvent acetone chamber
Potential impact on the health and safety of the practitioner	<p>1. Handling acetone poses a health risk as the solvent is flammable and irritant. Work under a fume hood or fume box, protective gloves, and protective goggles is required.</p> <p>2. Handling ethyl acetate poses a health risk as the solvent is flammable and irritant. Work under a fume hood or fume box, protective gloves, and protective goggles is required.</p>	<p>No health cautions with the exception of the risk of cutting oneself on the scalpel.</p>	<p>Health cautions include the risk of burning oneself, cause of fire, and ingesting harmful vapors or fumes would the plastic reach its boiling point. Cotton gloves may be worn as a slight protective barrier when handling the heat spatula.</p>	<p>Health cautions include the risk of burning oneself, cause of fire, and ingesting harmful vapors or fumes would the plastic reach its boiling point. Cotton gloves may be worn as a slight protective barrier when handling the object on and off the hot plate.</p>	<p>1. Handling acetone poses a health risk as the solvent is flammable and irritant. Work under a fume hood or fume box, protective gloves, and protective goggles is required.</p> <p>2. Handling ethyl acetate poses a health risk as the solvent is flammable and irritant. Work under a fume hood or fume box, protective gloves, and protective goggles is required.</p>	<p>1. Handling acetone poses a health risk as the solvent is flammable and irritant. Work under a fume hood or fume box, protective gloves, and protective goggles is required.</p>

	Cotton poultice chamber 1. Acetone 2. Ethyl acetate	Mechanical removal with scalpel	Local heat removal (48-60 celsius)	Overall heat removal	Direct solvent application 1. Acetone 2. Ethyl acetate	Solvent acetone chamber
Resources required to perform the respective techniques and methods	1. Acetone, fume box, bottle, cotton, pipette, scalpel 2. Ethyl acetate, fume box, bottle, cotton, pipette, scalpel	Scalpel	Heat spatula, vlieseline, scalpel	Burner, vlieseline, scalpel	1. Acetone, fume box, pipette, cotton swab, scalpel 2. Ethyl acetate, fume box, pipette, cotton swab, scalpel	Acetone, fume box, bottle, cotton, pipette, scalpel
Tidelines/ discolouration	1. Bad 2. Bad	None	None	None	1. Severe 2. Bad	Notable
An overall score on the ease of the delamination procedure, where 1 is the hardest and 10 the easiest.	1. 3 2. 3	1	2	5	1. 2 2. 2	4
An overall score on the success of the delamination procedure, where 1 was least successful and 10 most successful.	1. 5 2. 5	4	4	7	1. 3 2. 3	5
Total score, where the greatest number equals the greatest result.	1. 8 2. 8	5	6	12	1. 5 2. 5	9



[Fig. 38] Results from delamination of all pieces.

Left column top-to-down: 1. Localized heat removal, 2. Overall heat removal, 3. Local ethyl acetate application, 4. Ethyl acetate poultice chamber.

Right column top-to-down: 1. Acetone solvent chamber, 2. Mechanical removal, 3. Local acetone application, 4. Acetone poultice chamber



Fig. 39 (left), 40 (middle) & 41 (right)

Solubility test of ink. To the left, ethyl acetate. To the right, acetone. In the middle, the samples and their respective solvents. As demonstrated, the acetone showcased greater bleeding of the ink than the ethyl acetate.

4. Discussion

In the grading of the results from the experiments where applications of methods for PST-removal on this research's PSA-laminated paper object, the following parameters were factored in:

- Appearance of paper surface
- Legibility of text
- Extent of removal of the modified polymer lamination
- Extent of removal of the laminate adhesive
- Surface abrasion
- Planar distortion of the paper surface
- Retainment of ink medium
- Treatment time required
- Resources required to perform the respective techniques and methods
- Environmental impact of materials used
- Potential impact on the health and safety of the practitioner when utilizing the respective techniques and methods
- Tidelines/discolouration
- An overall score on the ease of the delamination procedure.
- An overall score on the success of the delamination procedure.

In each parameter, the outcome were described after the data obtained by empirical observation during and throughout the experiments. An overall score of difficulty were also prescribed to each method, with a score of 1 being the most difficult and 10 the least difficult. Another overall score of success were also prescribed to each method, with a score of 1 being the least successful and 10 the most

successful. A total score, including the score of ease and the score of success, were then prescribed to each method as well. As both ease and success would result in a higher score in the aforementioned grading, the higher the total score, the better the results.

The results would agree with the claim, that the usage of mechanical methods alone is not sufficient and feasible in the delamination of a PSA-laminated paper object (Griffin & O'Regan 2019, 244). However, whereas delamination through the usage of solvents is recommended after the interpretation of their results, overall heat removal seem, by the results, a better fit for this research object. However, the results from the overall heat removal might not be applicable to all PSA-laminated objects, but limited to the research object in question.

The research object likely consists of wood pulp paper. Because of its natural content of lignin, wood pulp paper is susceptible to acidity and is therefore often frail and fragile. When solvents were used in the delamination of the research object, there was significant damage done to the aesthetics and legibility of the object post-delamination. Furthermore, there occurred tidelines, which does not only affect the appearance of the paper, but also stability, as tidelines structurally weaken the paper after drying. Because the paper will be softer where the tidelines are located, there is a heightened risk that material loss will occur as the object is handled.

Immersion in solvents, particularly acetone, has been recommended in several publications regarding the delamination of cellulose acetate (CA) laminated paper objects. CA-lamination is, unlike PSA-lamination, a hot-set lamination technique. As PSA-laminations do not pertain to the usage of cellulose acetate and a thermal activation of the adhesive, delamination through immersion in acetone is not necessarily applicable.

The results from the application of PST-removal on PSA-laminated paper shares the experience of mechanical removal being insufficient and unsatisfactory. However, the method that involved direct application of (1) acetone/(2) ethyl acetate did not yield satisfactory results either.

The delamination results from the acetone chamber and cotton chamber poultices of (1) acetone/(2) ethyl acetate were more sufficient and satisfactory, but still showcased reasons of concern such as a significant decline in the research object's appearance as well as legibility. Griffin and O'Regan claim that 'when acetone is applied in gels and poultices or in vapour form [like that of a solvent chamber], or used for blotter washing or spray washing, [the ABF-removal] was less effective than in immersion washing' (2019, 244).

They continue to say, that the consequences that followed were that the removal became less efficient, increasing the required time for removal. This does not only translate to a greater need of resources, but also that the object that has been assigned the ABF-removal undergoes further stress and a heightened risk for damage as its treatment extended. For the ABF-laminated object of Griffin and O'Regan specifically, this meant a heightened risk of media migration and stress from the force of the mechanical removal that became required to remove the ABF-laminate. Using force from mechanical removal, naturally heightens the risk of damage to the object such as abrasion and tearing.

Despite the addition of mechanical removal, Griffin and O'Regan found that there was a notable amount of adhesive residue after removal despite efforts to remove it. Roberts and Etherington agree, describing the removal of ABFs as 'difficult to accomplish', in that 'generally more than one treatment is required to removal all traces of the laminate' (2011, 231). Motivated by the results retrieved from the

mechanical removal, Griffin and O'Regan conclude that 'removal of ABF with mechanical methods only is not feasible and the use of an organic solvent is required, with acetone proving the most effective' (2019, 244).

Whereas the application of acetone utilizing gels, poultices, and vapour were motivated by the recommendation to not use large quantities of the solvent due to associated health risks as well as expenses, it was later found from the results of said removals that these objects had been sprayed-washed, resulting in a total amount of acetone that likened to the required amount for a sequence of immersion washing in reusable acetone baths. Griffin and O'Regan concluded from their research, that immersion washing in acetone is, at the present time of writing the paper, the preferred approach in regards to their retrieved results. They recommend, by delaminating larger batches of ABF-laminated objects with immersion washing, the acetone allows for re-use as long as an overhead fume extractor or fume cupboard is utilized throughout the washing to regulate the air flow.

5. Summary

Delamination of PSA-laminated paper through overall heat application provided the best results across the majority of parameters. Overall heat application had the highest rate of success when it came to retaining the surface ink medium with a score of 7 out of 10, where 10 is the most successful. Overall heat application also caused the least amount of abrasion and planar distortion. However, whereas the overall heat application was successful in removing the plastic carrier, it had little success in removal of the adhesive.

Meanwhile, the method of PST-removal that was the most successful at the removal of the adhesive was the acetone/ethyl acetate cotton poultice chamber, mechanical removal, and the direct solvent application of acetone/ethyl acetate. However, the surface abrasion was severe in the mechanical removal, as was it with ethyl acetate cotton poultice. While not as severe, there was also a significant amount of surface abrasion from the acetone cotton poultice and the direct solvent application of acetone/ethyl acetate.

In regards to the planar distortion of the paper, mechanical removal resulted in minimal planar distortion. As did the direct solvent application utilizing ethyl acetate. Compared to acetone, the cotton poultice chamber with ethyl acetate did also cause less planar distortion than both the cotton poultice acetone chamber and direct solvent application of acetone.

Simultaneously, the acetone in the cotton poultice chamber and direct solvent application had less affect on the appearance of the paper page's surface and retained the surface ink medium better than the cotton poultice chamber and direct solvent application of ethyl acetate.

In regards to the overall score, the direct solvent application of acetone/ethyl acetate wielded the least successful results in the delamination of the PSA-laminated research object with a score of 3 out of 10, where 10 is the most successful. Followed after with a score of 4 out of 10, was the success from the mechanical removal and the local heat removal.

In the concluding grade score, where the parameters of both delamination success and the ease of delamination are included, the mechanical removal and direct solvent application of acetone/ethyl acetate had the lowest grade score of 5. Delamination through local heat removal yielded slightly better

results with a grade score of 6. Meanwhile, the overall heat removal which yielded the best results across the majority of parameters, had the highest grade score of 12, which is double the success rate of the local heat removal.

6. Conclusions

Referring back to the summary as well as the results table on p. 41-57, delamination through overall heat removal was found to be the most successful in terms of affect on the paper and ease of removal. In second place, came the solvent acetone chamber. And in third, the cotton poultice chamber using acetone and ethyl acetate.

However, the results obtained from these experiments are not found satisfactory or reliable enough in their outcome to endorse a recommendation for future delaminations of PSA-laminated paper. The outcome of the delamination of this paper's research object is specific to said object, wherefore the results are restricted to the object's unique material properties. In addition, the outcome of each delamination utilizing PST-removal techniques resulted in considerate if not major loss of the material body. The results did not present aesthetic benefits either, to combat or make up for the reduced integrity. Legibility of the object was also lost, as was readability.

Conducting a fibre analysis of the paper would provide certainty in identifying the paper material, which has been speculated to be wood pulp paper (see: documentation on p. 31-33). However, identification of the object's paper fibre would not substantially affect the outcome of the conducted experimental methods. Consequently, a fibre identification would not provide anything of substance in the results of this paper.

Among conservation practitioners, there is a consensus of agreement that laminations are an irreversible treatment that should not be performed as lamination does not possess or present benefits for the preservation of objects. However, there remains a knowledge gap on how to address laminated objects in collections. Laminations are irreversible, but is there any method that could establish and present an appropriate method of delamination? If not, is it possible to establish a standard protocol for the maintenance of laminated objects, in regards to delay the deterioration process of the objects? And what risks could such protocol present, as the affected objects may become less accessible to the public in their captivity within 'perfect' conditions?

A third viable course of research, would be to examine the option of preserving laminated paper objects by digitizing them. Technology today allows for preservation photocopies, such as professional repro-cams to create high-resolute facsimiles. However, this opens up for the discussion of whether or not it is, on its own, an appropriate option for the conservation of affected objects. What happens to the material values, when an object goes from material to immaterial? How could sole access to the digital photocopy but not the original object affect its values? Does the digital photocopy, through its first creation, also become original? Original on its own, or in conjunction to its material origin? How is it possible to guarantee that digital photocopies are safeguarded, under the threat of cyber attacks and malware? Could digitization as a preservation method support present and prompt new challenges in the de-colonisation of cultural heritage? What other risks are there, that we may or may not know of at this time? These are all thought-provoking questions, that are worth investigating further.

While aesthetic value is and can be important for the integrity of each respective object, when these are previously treated with pressure-sensitive tape or pressure-sensitive adhesive lamination it is necessary to thoroughly dissect how appropriate it is to make an attempt at the removal of the PST or PSA-lamination. It remains to discover and implement a satisfactory removal method of tapes and laminations. The methods that are yet known are, if not only difficult to perform, also time-consuming and impose greater risks than benefits to the object in its preservation.

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Information on ethyl acetate. Chemical properties, health concerns, waste disposal, and more.

Attachment 3 EFKA 4403. pp. 78-80

Information on EFKA 4403 which the FTIR-scanner recognized the PSA-laminate as.
Chemical properties and more.

Attachment 4 LIQUIN. pp. 81-92

Information on liquin which the FTIR-scanner recognized the adhesive (curing agent) as.
Chemical properties and more.

Acetone

Modified 2022-01-25

CAS number: **67-64-1** EU number: **200-662-2** Klara-id: **9075**SummaformelFormula: **C3H6O****Synonyms**Aceton Kemiskt ren, Acetonium, Acetonum Eur,
Dimetylketon, Propan-2-on, Propanon,**Article number**

Sigma-Aldrich Sweden AB	00585
Supelco	1.00014
VWR International	1.00014.2500, 1.00014.2500
Merck	100012, 100014
Supelco	100014, 100020
Merck	100020, 100299
Fisher Scientific	10131560, 10652241
Solveco AB	1078, 1078
Honeywell	179124
Sigma-Aldrich Sweden AB	179124
Scharlau	20.066.296
VWR International	20.066.321, 20014, 20014-25, 20063, 20063.365, 20063.558, 20065, 20065.327, 20065.362, 20065.362P, 20066, 20066.296, 20066.330, 20067
Alfort & Cronholm AB	203005
Nitor AB	203005, 237621
Alfort & Cronholm AB	237621, 237622
Nitor AB	237622
Sigma-Aldrich Sweden AB	24201, 270725
Apoteket AB	30019, 320325
Sigma-Aldrich Sweden AB	32201-155
Acros Organics	326800000, 326800010, 326801000
Biltema Sweden AB	36707
Sigma-Aldrich Sweden AB	40289
VWR International	50488858
Chemtronica	528201, 528203
Sigma-Aldrich Sweden AB	534064
Abbott Scandinavia AB	5434343
Akzo Nobel Decorative Coatings	6020482, 6020485
Sigma-Aldrich Sweden AB	650501
VWR International	65454
BDH Chemicals	67-64-1
Labassco AB	8002
Supelco	822251
Merck	991245
Fisher Scientific	A/0606/17
Tamro Medlab AB	Baker 07-800201
VWR International	C01C11X, E646
Brunner AB	R5060

Carl Roth **T906**
GmbH

CLP classification

2.6	2.6 – Flammable liquids, Hazard Category 2
3.3	3.3 – Serious eye damage/eye irritation, Hazard Category 2
3.8	3.8 – Specific target organ toxicity – Single exposure, Hazard Category 3, Narcosis



Danger

Hazard statements CLP

- EUH066** Repeated exposure may cause skin dryness or cracking.
H225 Highly flammable liquid and vapour.
H319 Causes serious eye irritation.
H336 May cause drowsiness or dizziness.

Precautionary statements CLP

- P210** Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P233 Keep container tightly closed.
P240 Ground and bond container and receiving equipment.
P241 Use explosion-proof electrical/ventilating/lighting/.../equipment. OBSERVE! This precautionary statement has to be specified by the supplier. See the Material Safety Data Sheet for the exact formulation.
P242 Use non-sparking tools.
P243 Take precautionary measures against static discharge.
P280 Wear protective gloves/protective clothing/eye protection/face protection/hearing protection/... OBSERVE! This precautionary statement has to be specified by the supplier. See the Material Safety Data Sheet for the exact formulation
P304
+ IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
P340
P305
+
P351 Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
+
P338
P312 Call a POISON CENTER/doctor/ ... if you feel unwell.
P403
+ Store in a well-ventilated place. Keep cool.
P235

Regulations

- **Occupational Exposure Limit Values exist on product** Listing of chemical substances or mixture that have Occupational Exposure Limit Values. Check-date 2022-02-04.
AFS 2021-03 2021-09-27

Other lists

- Exposure scenario included in SDS Exposure scenario included in SDS.
Kontinuerligt / Continuously
- Volatile organic compounds (VOC) A VOC is any organic compound having an initial boiling point less than or equal to 250 C, measured at a standard atmospheric pressure of 101.3 kPa. This list consists of VOCs that are the most common ones.
2020-11-17

Classification

Fire Flammable liquids and vapour/Flashpoint < 23°C
 Health No health classification
 Environment No environment classification

SAFETY DATA SHEET

according to Regulation (EC) No. 1907/2006

Version 8.1
Revision Date 30.06.2021
Print Date 15.08.2022

GENERIC EU MSDS - NO COUNTRY SPECIFIC DATA - NO OEL DATA

SECTION 1: Identification of the substance/mixture and of the company/undertaking**1.1 Product identifiers**

Product name : Ethyl acetate

Product Number : 270989

Brand : Sigma-Aldrich

Index-No. : 607-022-00-5

REACH No. : 01-2119475103-46-XXXX

CAS-No. : 141-78-6

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

Company : Merck Life Science AB
Box 3033
SE-169 03 SOLNA

Telephone : +46 08 742-4200

Fax : +46 08 742-4243

E-mail address : TechnicalService@merckgroup.com

1.4 Emergency telephone

Emergency Phone # : +(46)-852503403 (CHEMTREC)
Vid akut fara för liv, egendom eller miljö -
112

SECTION 2: Hazards identification**2.1 Classification of the substance or mixture****Classification according to Regulation (EC) No 1272/2008**

Flammable liquids (Category 2), H225

Eye irritation (Category 2), H319


Specific target organ toxicity - single exposure (Category 3), Central nervous system, H336

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 Label elements**Labelling according Regulation (EC) No 1272/2008**

Pictogram



Signal word	Danger
Hazard statement(s)	
H225	Highly flammable liquid and vapor.
H319	Causes serious eye irritation.
H336	May cause drowsiness or dizziness.
Precautionary statement(s)	
P210	Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P233	Keep container tightly closed.
P240	Ground and bond container and receiving equipment.
P241	Use explosion-proof electrical/ ventilating/ lighting/ equipment.
P242	Use non-sparking tools.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
Supplemental Hazard information (EU)	
EUH066	Repeated exposure may cause skin dryness or cracking.
Reduced Labeling (<= 125 ml)	
Pictogram	
Signal word	Danger
Hazard statement(s)	none
Precautionary statement(s)	none
Supplemental Hazard information (EU)	
EUH066	Repeated exposure may cause skin dryness or cracking.

2.3 Other hazards

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

SECTION 3: Composition/information on ingredients

3.1 Substances

Formula	: C ₄ H ₈ O ₂
Molecular weight	: 88,11 g/mol
CAS-No.	: 141-78-6
EC-No.	: 205-500-4
Index-No.	: 607-022-00-5

Component		Classification	Concentration
ethyl acetate			
CAS-No.	141-78-6	Flam. Liq. 2; Eye Irrit. 2; STOT SE 3; H225, H319, H336 Concentration limits: 20 %: STOT SE 3, H336;	<= 100 %
EC-No.	205-500-4		
Index-No.	607-022-00-5		

For the full text of the H-Statements mentioned in this Section, see Section 16.

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The life science business of Merck operates as MilliporeSigma in the US and Canada



SECTION 4: First aid measures

4.1 Description of first-aid measures

General advice

Show this material safety data sheet to the doctor in attendance.

If inhaled

After inhalation: fresh air. Call in physician.

In case of skin contact

In case of skin contact: Take off immediately all contaminated clothing. Rinse skin with water/ shower.

In case of eye contact

After eye contact: rinse out with plenty of water. Call in ophthalmologist. Remove contact lenses.

If swallowed

After swallowing: immediately make victim drink water (two glasses at most). Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed

No data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media

Carbon dioxide (CO₂) Foam Dry powder

Unsuitable extinguishing media

For this substance/mixture no limitations of extinguishing agents are given.

5.2 Special hazards arising from the substance or mixture

Carbon oxides

Combustible.

Pay attention to flashback.

Vapors are heavier than air and may spread along floors.

Risk of dust explosion.

Development of hazardous combustion gases or vapours possible in the event of fire.

Forms explosive mixtures with air at ambient temperatures.

5.3 Advice for firefighters

In the event of fire, wear self-contained breathing apparatus.

5.4 Further information

Remove container from danger zone and cool with water. Prevent fire extinguishing water from contaminating surface water or the ground water system.



SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Advice for non-emergency personnel: Do not breathe vapors, aerosols. Avoid substance contact. Ensure adequate ventilation. Keep away from heat and sources of ignition. Evacuate the danger area, observe emergency procedures, consult an expert. For personal protection see section 8.

6.2 Environmental precautions

Do not let product enter drains. Risk of explosion.

6.3 Methods and materials for containment and cleaning up

Cover drains. Collect, bind, and pump off spills. Observe possible material restrictions (see sections 7 and 10). Take up with liquid-absorbent material (e.g. Chemizorb®). Dispose of properly. Clean up affected area.

6.4 Reference to other sections

For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on safe handling

Work under hood. Do not inhale substance/mixture. Avoid generation of vapours/aerosols.

Advice on protection against fire and explosion

Keep away from open flames, hot surfaces and sources of ignition. Take precautionary measures against static discharge.

Hygiene measures

Change contaminated clothing. Preventive skin protection recommended. Wash hands after working with substance. For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Storage conditions

Keep container tightly closed in a dry and well-ventilated place. Keep away from heat and sources of ignition.

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Ingredients with workplace control parameters

Derived No Effect Level (DNEL)

Application Area	Routes of exposure	Health effect	Value
Workers	Inhalation	Acute systemic effects	1468 mg/m ³
Workers	Inhalation	Acute local effects	1468 mg/m ³
Workers	Skin contact	Long-term systemic effects	63mg/kg BW/d
Workers	Inhalation	Long-term systemic effects	734 mg/m ³
Workers	Inhalation	Long-term local effects	734 mg/m ³
Consumers	Inhalation	Acute local effects, Acute systemic	734 mg/m ³



		effects	
Consumers	Skin contact	Long-term systemic effects	37mg/kg BW/d
Consumers	Inhalation	Long-term systemic effects	367 mg/m3
Consumers	Ingestion	Long-term systemic effects	4,5mg/kg BW/d
Consumers	Inhalation	Long-term local effects	367 mg/m3

Predicted No Effect Concentration (PNEC)

Compartment	Value
Soil	0,24 mg/kg
Sea water	0,026 mg/l
Fresh water	0,26 mg/l
Sea sediment	0,125 mg/kg
Fresh water sediment	1,25 mg/kg

8.2 Exposure controls

Personal protective equipment

Eye/face protection

Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU). Safety glasses

Skin protection

This recommendation applies only to the product stated in the safety data sheet, supplied by us and for the designated use. When dissolving in or mixing with other substances and under conditions deviating from those stated in EN374 please contact the supplier of CE-approved gloves (e.g. KCL GmbH, D-36124 Eichenzell, Internet: www.kcl.de).

Splash contact

Material: butyl-rubber

Minimum layer thickness: 0,7 mm

Break through time: 120 min

Material tested: Butoject® (KCL 898)

Body Protection

Flame retardant antistatic protective clothing.

Respiratory protection

Recommended Filter type: Filter A (acc. to DIN 3181) for vapours of organic compounds

The entrepreneur has to ensure that maintenance, cleaning and testing of respiratory protective devices are carried out according to the instructions of the producer.

These measures have to be properly documented.

Control of environmental exposure

Do not let product enter drains. Risk of explosion.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

- a) Appearance Form: clear, liquid
 Color: colorless

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b) Odor	No data available
c) Odor Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	Melting point/range: -84 °C
f) Initial boiling point and boiling range	76,5 - 77,5 °C
g) Flash point	-4 °C - closed cup
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	Lower explosion limit: 2,2 %(V)
k) Vapor pressure	No data available
l) Vapor density	No data available
m) Relative density	No data available
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	No data available
p) Autoignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	Viscosity, kinematic: No data available Viscosity, dynamic: No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

9.2 Other safety information

No data available

SECTION 10: Stability and reactivity

10.1 Reactivity

Vapors may form explosive mixture with air.

10.2 Chemical stability

The product is chemically stable under standard ambient conditions (room temperature) .

10.3 Possibility of hazardous reactions

Risk of ignition or formation of inflammable gases or vapours with:

Exothermic reaction with:

Fluorine

chlorosulfonic acid

Strong oxidizing agents

fuming sulfuric acid



Risk of explosion with:
lithium aluminium hydride
Alkali metals
hydrides
Alkaline earth metals
Violent reactions possible with:
Strong acids and strong bases

10.4 Conditions to avoid

Warming.

10.5 Incompatible materials

various plastics

10.6 Hazardous decomposition products

In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

LD50 Oral - Rat - 5.620 mg/kg

Remarks: (RTECS)

Inhalation: No data available

LD50 Dermal - Rabbit - male - > 20.000 mg/kg

Remarks: (ECHA)

Skin corrosion/irritation

Skin - Rabbit

Result: No skin irritation

Remarks: (IUCLID)

Serious eye damage/eye irritation

Eyes - Rabbit

Result: slight irritation

(OECD Test Guideline 405)

Remarks: (Regulation (EC) No 1272/2008, Annex VI)

Respiratory or skin sensitization

Maximization Test - Guinea pig

Result: negative

(OECD Test Guideline 406)

Germ cell mutagenicity

Test Type: UDS (Unscheduled DNA synthesis assay)

Test system: Escherichia coli

Metabolic activation: with and without metabolic activation

Method: US-EPA

Result: negative

Test Type: Ames test

Test system: Salmonella typhimurium

Metabolic activation: with and without metabolic activation

Method: OECD Test Guideline 471

Result: negative

Test Type: Chromosome aberration test in vitro

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Test system: Chinese hamster ovary cells
Metabolic activation: with and without metabolic activation
Method: OECD Test Guideline 473
Result: negative

Test Type: Micronucleus test
Species: Chinese hamster
Cell type: Red blood cells (erythrocytes)
Application Route: Oral
Method: OECD Test Guideline 474
Result: negative

Carcinogenicity

No data available

Reproductive toxicity

No data available

Specific target organ toxicity - single exposure

May cause drowsiness or dizziness. - Central nervous system

Specific target organ toxicity - repeated exposure

No data available

Aspiration hazard

No data available

11.2 Additional Information

Repeated dose toxicity - Rat - male and female - Oral - 92 Days - NOAEL (No observed adverse effect level) - 900 mg/kg - LOAEL (Lowest observed adverse effect level) - 3.600 mg/kg

RTECS: AH5425000

Inhalation of high concentrations may cause:, Headache, Drowsiness, Dizziness, Vomiting, narcosis, anemia, Central nervous system depression

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Kidney - Irregularities - Based on Human Evidence

SECTION 12: Ecological information

12.1 Toxicity

Toxicity to fish	flow-through test LC50 - Pimephales promelas (fathead minnow) - 230 mg/l - 96 h (US-EPA)
Toxicity to algae	static test NOEC - Desmodesmus subspicatus (green algae) - > 100 mg/l - 72 h (OECD Test Guideline 201)

12.2 Persistence and degradability

Biodegradability	aerobic - Exposure time 20 d Result: ca.69 % - Readily biodegradable. Remarks: (ECHA)
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Theoretical oxygen demand 1.820 mg/g
Remarks: (Lit.)

12.3 Bioaccumulative potential

No data available

12.4 Mobility in soil

No data available

12.5 Results of PBT and vPvB assessment

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

12.6 Other adverse effects

No data available

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product

See www.retrologistik.com for processes regarding the return of chemicals and containers, or contact us there if you have further questions.

SECTION 14: Transport information

14.1 UN number

ADR/RID: 1173 IMDG: 1173 IATA: 1173

14.2 UN proper shipping name

ADR/RID: ETHYL ACETATE
IMDG: ETHYL ACETATE
IATA: Ethyl acetate

14.3 Transport hazard class(es)

ADR/RID: 3 IMDG: 3 IATA: 3

14.4 Packaging group

ADR/RID: II IMDG: II IATA: II

14.5 Environmental hazards

ADR/RID: no IMDG Marine pollutant: no IATA: no

14.6 Special precautions for user

No data available

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

This material safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006.

National legislation

Seveso III: Directive 2012/18/EU of the European : FLAMMABLE LIQUIDS



Parliament and of the Council on the control of major-accident hazards involving dangerous substances.

Other regulations

Take note of Dir 94/33/EC on the protection of young people at work.

15.2 Chemical Safety Assessment

A Chemical Safety Assessment has been carried out for this substance.

SECTION 16: Other information

Full text of H-Statements referred to under sections 2 and 3.

EUH066	Repeated exposure may cause skin dryness or cracking.
H225	Highly flammable liquid and vapor.
H319	Causes serious eye irritation.
H336	May cause drowsiness or dizziness.

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

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In touch, in depth, invaluable.

BASF Performance and Formulation Additives

North America, May 2019

 **BASF**
We create chemistry

Dispersing agents

Technical Information, features and benefits

Product name	Description	Solids (%)	Amine number (mg KOH/g)	Acid value (mg KOH/g)	VOC content (%)	Recommended for low-VOC systems	Recommended for			Features and benefits
							Water-based systems	Solvent-based systems	Solvent-free systems	
High molecular weight dispersing agents										
Disperx® Ultra PX 4525	Blend of amine- and acid-functional polymers	92	16	33	<1	●			●	Universal wetting and dispersing agent; improves gloss development, color intensity and color acceptance
Disperx® Ultra PX 4575	Acrylic block copolymer made by controlled free radical polymerization (C-FRP)	40	32	-	<0,1	●			●	VOC-free dispersing agent for water-based systems with benchmark performance in inorganic pigments; excellent overall performance for organic pigments; broad compatibility towards different resin systems; designed for colorants but well suited for primers and primers; gloss and semi gloss-paints
Disperx® Ultra PX 4585	Acrylic block copolymer made by controlled free radical polymerization (C-FRP)	50	20	-	<0,1	●			●	High-end water-based coatings, industrial and automotive; broad compatibility with different binder systems; pH-independent; suitable for making resin-free pigment concentrates
Eka® PA 4400	Modified polyacrylate polymer	40	42	-	60		●			Specifically used in coil coating applications and polyester / melamine stoving enamels
Eka® PA 4401	Modified polyacrylate polymer	50	50	-	50		●			Industrial coatings; transportation topcoats; excellent (viscosity depression) for industrial colorants (pigment pastes) in combination with grinding resins such as Laropar® A81
Eka® PA 4403	Modified polyacrylate polymer	55	35	-	45		●			For industrial colorants (pigment pastes) in combination with grinding resins such as Laropar® A 81
Eka® PA 4404	Modified polyacrylate polymer	40	42	-	60		●			Specifically used in coil coating applications and polyester / melamine stoving enamels; reduced residual monomer content
Eka® PA 4450	Cationic-functional polymer	50	-	110	50		●		●	Polymeric dispersing agent for organic and inorganic pigments in non-aqueous systems; especially designed for high-quality coatings and pigment concentrates
Eka® PU 4009	Modified polyurethane polymer	60	9	13	40		●			General industrial coatings where cost-efficiency is vital
Eka® PU 4010	Modified polyurethane polymer	51	6	12	49		●		●	General industrial coatings; wood coatings for stabilization of TiO ₂ and matting agents
Eka® PU 4015	Modified polyurethane polymer	50	10	-	50		●			Solvent-based industrial coatings; low viscosity in high-pigmented systems
Eka® PU 4020	Modified polyurethane polymer	65	9	-	35		●			Aromatic-free dispersing agent for solvent-based industrial coatings and decorative coatings and colorants
Eka® PU 4046	Modified polyurethane polymer	40	19	-	60		●		●	For general industrial coatings
Eka® PU 4047	Modified polyurethane polymer	35	17	-	65		●		●	High-quality industrial finishes including automotive OEM and refinish
Eka® PU 4050	Modified polyurethane polymer	45	14	-	55		●		●	High-quality industrial finishes including automotive OEM and refinish, as well as resin-containing pigment concentrates
Eka® PU 4051	Modified polyurethane polymer	30	8	-	70		●			High-quality industrial, automotive and refinish applications; strong viscously-depressing properties
Eka® PU 4063	Modified polyurethane polymer	45	10	-	55		●		●	Polymeric dispersing agent for the deblockade of inorganic and organic pigments in high-quality solvent-based pigment pastes
Eka® PU 4080	Modified polyurethane polymer	30	4	-	70		●			Strong viscously-depressing properties in high-end applications such as automotive, OEM and coil coatings
Eka® PX 4300	Acrylic block copolymer made by controlled free radical polymerization (C-FRP)	80	56	-	20		●			Solvent-based industrial coatings including medium- and long-oil alkyls
Eka® PX 4310	Acrylic block copolymer made by controlled free radical polymerization (C-FRP)	50	19	-	50		●			High-quality solvent-based industrial and automotive coatings; setting new standards as a dispersing agent for resin-free pigment pastes for coil coatings and dispersing agent for carbon blacks giving extremely high fineness
Eka® PX 4320	Acrylic block copolymer made by controlled free radical polymerization (C-FRP)	50	28	-	50		●			High-quality solvent-based industrial coatings; being less polar compared to Eka® PX 4310; demonstrates better suitability for thermoplastic acrylics
Eka® PX 4330	Acrylic block copolymer made by controlled free radical polymerization (C-FRP)	70	28	-	30		●			Solvent-based industrial and decorative coatings; excellent (broad compatibility) for industrial colorants (pigment pastes) in combination with grinding resins such as Laropar® A81
Eka® PX 4340	Acrylic block copolymer made by controlled free radical polymerization (C-FRP)	55	4	-	45		●			Solvent-based high-end applications, industrial, automotive systems; good performance in CAB-modified systems but also with 2-pack PU-B and 2-pack epoxies

* Recommended for low-VOC paints and coatings if VOC content < 5%
Maximum recommended concentration to the EU Standard 2014/53/2/EU for interior and exterior paints and varnishes.
For products with a VOC level above 15% the value is based on calculation according to recipe.

[illegible]

The data in the product selector table is a first recommendation. Suitability of a product should always be checked in the actual paint, coating or ink.

WINSOR & NEWTON OIL COLOUR LIQUIN ORIGINAL

Safety Data Sheet

according to the REACH Regulation (EC) 1907/2006 amended by Regulation (EU) 2020/878
Issue date: 18/02/2022 Revision date: 18/02/2022 Supersedes version of: 15/03/2021 Version: 10.0

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product form : Mixture
Trade name : WINSOR & NEWTON OIL COLOUR LIQUIN ORIGINAL
Product group : Trade product

1.2. Relevant identified uses of the substance or mixture and uses advised against

1.2.1. Relevant identified uses

Intended for general public
Main use category : Consumer use
Use of the substance/mixture : Artists', craft and hobby paints

1.2.2. Uses advised against

No additional information available

1.3. Details of the supplier of the safety data sheet

Supplier

COLART EUROPE SAS SAS
5 rue René Panhard 72021 Le Mans Cedex 2
72021 LeMans
France
T +44 208 424 3270
r.enquiries@colart.co.uk

Supplier

COLART UK LTD
Goldthorn Road
DY11 7JN Kidderminster – Worcestershire
United Kingdom
T +44 (0) 2084243200
r.enquiries@colart.co.uk

Distributor

Jasco Pty (NZ) Limited
5 Airpark Drive, Airport Oaks, Auckland Airport Auckland
P.O. Box 107010

Other

Colart International Holdings LTD
The MediaWorks Building
191 Wood Lane
GB– W12 7FP London – London
United Kingdom
T 02084243200
r.enquiries@colart.co.uk

Manufacturer

Colart France
Zone Industrielle Nord 5 Rue René Panhard, +33 2 43 83 83 00
Le Mans
France
r.enquiries@colart.co.uk

Distributor

JASCO
1-5 Commercial Road Kingsgrove
+61– NSW 2208 New South Wales
T 029807 1555

1.4. Emergency telephone number

Emergency number : +33 2 43 83 83 00 (Monday- Thursday: 8:00-12:00 13:30-16:00 , Friday: 8:00-12:00 CET
Language French); (+44) 2084243200 Monday-Friday: 9:00-17:00 GMT Language English)

Country	Organisation/Company	Address	Emergency number	Comment
Australia	NSW Poisons Information Centre The Children's Hospital at Westmead	Locked Bag 4001 NSW 2145 Westmead	13 11 26	
New Zealand	New Zealand National Poison Centre Dunedin School of Medicine, University of Otago	PO Box 56 Dunedin 9054	0800 764 766 (0800 POISON)	
United Kingdom	National Poisons Information Service (Birmingham Centre) City Hospital	Dudley Road B18 7QH Birmingham	0344 892 0111	

WINSOR & NEWTON OIL COLOUR LIQUIN ORIGINAL

Safety Data Sheet

according to the REACH Regulation (EC) 1907/2006 amended by Regulation (EU) 2020/878

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classification according to Regulation (EC) No. 1272/2008 [CLP]

Not classified

Adverse physicochemical, human health and environmental effects

No additional information available

2.2. Label elements

Labelling according to Regulation (EC) No. 1272/2008 [CLP]

Child-resistant fastening : Not applicable

Tactile warning : Not applicable

2.3. Other hazards

The mixture does not contain substance(s) included in the list established in accordance with Article 59(1) of REACH for having endocrine disrupting properties, or is not identified as having endocrine disrupting properties in accordance with the criteria set out in Commission Delegated Regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605

SECTION 3: Composition/information on ingredients

3.1. Substances

Not applicable

3.2. Mixtures

Name	Product identifier	%	Classification according to Regulation (EC) No. 1272/2008 [CLP]
Hydrocarbons, C11-14, n-alkanes, isoalkanes, cyclics, <2% aromatics	CAS-No.: 64742-47-8 EC-No.: 265-149-8 REACH-no: 01-2119456620-43	30 – 50	Flam. Liq. 3, H226 Asp. Tox. 1, H304
HYDROCARBONS, C12-C16, ISOALKANES, CYCLICS, <2% AROMATICS	CAS-No.: 64742-47-8 EC-No.: 265-149-8	10 – 30	Asp. Tox. 1, H304
2-pentanone oxime	CAS-No.: 623-40-5 EC-No.: 484-470-6	1 – 3	Acute Tox. 4 (Oral), H302 Eye Irrit. 2, H319 Aquatic Chronic 3, H412
Xylene substance with a Community workplace exposure limit	CAS-No.: 1330-20-7 EC-No.: 215-535-7 EC Index-No.: 601-022-00-9 REACH-no: 01-2119488216-32	< 3	Flam. Liq. 3, H226 Acute Tox. 4 (Dermal), H312 Acute Tox. 4 (Inhalation), H332 Skin Irrit. 2, H315 Asp. Tox. 1, H304 STOT SE 3, H335 Eye Irrit. 2, H319 Aquatic Chronic 3, H412

Full text of H- and EUH-statements: see section 16

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures general : Never give anything by mouth to an unconscious person. If you feel unwell, seek medical advice (show the label where possible).

First-aid measures after inhalation : Allow affected person to breathe fresh air. Allow the victim to rest.

WINSOR & NEWTON OIL COLOUR LIQUIN ORIGINAL

Safety Data Sheet

according to the REACH Regulation (EC) 1907/2006 amended by Regulation (EU) 2020/878

First-aid measures after skin contact	: Remove affected clothing and wash all exposed skin area with mild soap and water, followed by warm water rinse. Repeated exposure may cause skin dryness or cracking.
First-aid measures after eye contact	: Rinse immediately with plenty of water. Obtain medical attention if pain, blinking or redness persists.
First-aid measures after ingestion	: Rinse mouth out with water. In all cases of doubt, or when symptoms persist, seek medical attention. Rinse mouth. Do NOT induce vomiting. Obtain emergency medical attention.

4.2. Most important symptoms and effects, both acute and delayed

No additional information available

4.3. Indication of any immediate medical attention and special treatment needed

Treat symptomatically.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media	: Foam. Dry powder. Carbon dioxide. Water spray. Sand.
Unsuitable extinguishing media	: Do not use a heavy water stream.

5.2. Special hazards arising from the substance or mixture

Fire hazard	: Combustible liquid.
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5.3. Advice for firefighters

Firefighting instructions	: Use water spray or fog for cooling exposed containers. Exercise caution when fighting any chemical fire. Prevent fire fighting water from entering the environment.
Protection during firefighting	: Do not enter fire area without proper protective equipment, including respiratory protection.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

6.1.1. For non-emergency personnel

Emergency procedures	: Evacuate unnecessary personnel.
----------------------	-----------------------------------

6.1.2. For emergency responders

Protective equipment	: Equip cleanup crew with proper protection.
Emergency procedures	: Ventilate area.

6.2. Environmental precautions

Prevent entry to sewers and public waters. Notify authorities if liquid enters sewers or public waters.

6.3. Methods and material for containment and cleaning up

Methods for cleaning up	: Soak up spills with inert solids, such as clay or diatomaceous earth as soon as possible. Collect spillage. Store away from other materials.
-------------------------	--

6.4. Reference to other sections

See Section 8. Exposure controls and personal protection.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling	: Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Provide good ventilation in process area to prevent formation of vapour.
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WINSOR & NEWTON OIL COLOUR LIQUIN ORIGINAL

Safety Data Sheet

according to the REACH Regulation (EC) 1907/2006 amended by Regulation (EU) 2020/878

7.2. Conditions for safe storage, including any incompatibilities

Storage conditions	: Keep only in the original container in a cool, well ventilated place away from : Keep container closed when not in use.
Incompatible products	: Strong bases. Strong acids.
Incompatible materials	: Sources of ignition. Direct sunlight.

7.3. Specific end use(s)

Refer to section 1.2.1.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

8.1.1 National occupational exposure and biological limit values

Xylene (1330-20-7)	
EU - Indicative Occupational Exposure Limit (IOEL)	
Local name	Xylene, mixed isomers, pure
IOEL TWA [ppm]	50 ppm
IOEL STEL	442 mg/m ³
IOEL STEL [ppm]	100 ppm
Remark	Skin
Regulatory reference	COMMISSION DIRECTIVE 2000/39/EC
France - Occupational Exposure Limits	
Local name	Xylène: mélange d'isomères
VME (OEL TWA)	221 mg/m ³
VME (OEL TWA) [ppm]	50 ppm
VLE (OEL C/STEL)	442 mg/m ³
VLE (OEL C/STEL) [ppm]	100 ppm
Remark	Valeurs réglementaires contraignantes; risque de pénétration percutanée
Regulatory reference	Article R4412-149 du Code du travail (réf.: INRS ED 984, 2016; Décret n° 2019-1487)
Germany - Occupational Exposure Limits (TRGS 900)	
Local name	Xylol (alle Isomeren)
AGW (OEL TWA) [1]	220 mg/m ³
AGW (OEL TWA) [2]	50 ppm
Peak exposure limitation factor	2(II)
Remark	DFG;EU;H
Regulatory reference	TRGS900
Germany - Biological limit values (TRGS 903)	
Local name	Xylol (alle Isomere)
Biological limit value	2000 mg/l Parameter: Methylhippur-(Tolur-) säure (alle Isomere) - Untersuchungsmaterial: U = Urin - Probenahmezeitpunkt: b) Expositionsende, bzw. Schichtende - Festlegung/Begründung: 11/2016 DFG
Regulatory reference	TRGS 903

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Xylene (1330-20-7)	
United Kingdom / Australia / New Zealand - Occupational Exposure Limits	
Local name	Xylene
WEL TWA (OEL TWA) [1]	220 mg/m ³ o-,m-,p- or mixed isomers
WEL TWA (OEL TWA) [2]	50 ppm o-,m-,p- or mixed isomers
WEL STEL (OEL STEL)	441 mg/m ³ o-,m-,p- or mixed isomers
WEL STEL (OEL STEL) [ppm]	100 ppm o-,m-,p- or mixed isomers
Remark	Sk (Can be absorbed through the skin. The assigned substances are those for which there are concerns that dermal absorption will lead to systemic toxicity)
Regulatory reference	EH40/2005 (Fourth edition, 2020). HSE
United Kingdom / Australia / New Zealand - Biological limit values	
Local name	Xylene, o-, m-, p- or mixed isomers
BMGV	650 mmol/mol Creatinine Parameter: methyl hippuric acid - Medium: urine - Sampling time: Post shift
Regulatory reference	EH40/2005 (Fourth edition, 2020). HSE

8.1.2. Recommended monitoring procedures

No additional information available

8.1.3. Air contaminants formed

No additional information available

8.1.4. DNEL and PNEC

Additional information : No exposure limits exist for this material

8.1.5. Control banding

No additional information available

8.2. Exposure controls

8.2.1. Appropriate engineering controls

No additional information available

8.2.2. Personal protection equipment

8.2.2.1. Eye and face protection

Eye protection:

Avoid contact with eyes

8.2.2.2. Skin protection

No additional information available

8.2.2.3. Respiratory protection

No additional information available

8.2.2.4. Thermal hazards

No additional information available

8.2.3. Environmental exposure controls

Other information:

Do not eat, drink or smoke during use. Ensure there is adequate ventilation.

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SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	: Liquid
Colour	: light brown.
Appearance	: Liquid.
Odour	: characteristic.
Odour threshold	: Not available
Melting point	: Not available
Freezing point	: Not available
Boiling point	: Not available
Flammability	: Non flammable.
Explosive limits	: Not available
Lower explosive limit (LEL)	: Not available
Upper explosive limit (UEL)	: Not available
Flash point	: 72 °C
Auto-ignition temperature	: Not available
Decomposition temperature	: Not available
pH	: Not available
Viscosity, kinematic	: > 20.5 mm ² /s
Solubility	: Not available
Partition coefficient n-octanol/water (Log Kow)	: Not available
Vapour pressure	: Not available
Vapour pressure at 50 °C	: Not available
Density	: Not available
Relative density	: Not available
Relative vapour density at 20 °C	: Not available
Particle size	: Not applicable
Particle size distribution	: Not applicable
Particle shape	: Not applicable
Particle aspect ratio	: Not applicable
Particle aggregation state	: Not applicable
Particle agglomeration state	: Not applicable
Particle specific surface area	: Not applicable
Particle dustiness	: Not applicable

9.2. Other information

9.2.1. Information with regard to physical hazard classes

No additional information available

9.2.2. Other safety characteristics

VOC content : < 0.1 %

SECTION 10: Stability and reactivity

10.1. Reactivity

The product is non-reactive under normal conditions of use, storage and transport.

10.2. Chemical stability

Stable at ambient temperature and under normal conditions of use. Not established.

10.3. Possibility of hazardous reactions

None under normal use. Not established.

10.4. Conditions to avoid

Direct sunlight. Extremely high or low temperatures.

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10.5. Incompatible materials

Strong acids. Strong bases.

10.6. Hazardous decomposition products

Carbon monoxide. Carbon dioxide. fume.

SECTION 11: Toxicological information

11.1. Information on hazard classes as defined in Regulation (EC) No 1272/2008

Acute toxicity (oral) : Not classified
Acute toxicity (dermal) : Not classified
Acute toxicity (inhalation) : Not classified

Xylene (1330-20-7)

LD50 dermal rabbit 12126 mg/kg bodyweight Animal: rabbit, Animal sex: male

Hydrocarbons, C11-14, n-alkanes, isoalkanes, cyclics, <2% aromatics (64742-47-8)

LD50 oral rat > 5000 mg/kg bodyweight Animal: rat, Guideline: EPA OTS 798.1175 (Acute Oral Toxicity), Guideline: OECD Guideline 420 (Acute Oral Toxicity - Fixed Dose Method)
LD50 dermal rabbit > 2000 mg/kg bodyweight Animal: rabbit, Guideline: EPA OTS 798.1100 (Acute Dermal Toxicity), Guideline: OECD Guideline 402 (Acute Dermal Toxicity)
LC50 Inhalation - Rat > 5.28 mg/l air Animal: rat, Guideline: OECD Guideline 403 (Acute Inhalation Toxicity), 95% CL: 0,42 -

2-pentanone oxime (623-40-5)

LD50 oral rat 1133 mg/kg bodyweight Animal: rat, Animal sex: female, Guideline: OECD Guideline 425 (Acute Oral Toxicity: Up-and-Down Procedure)
LC50 Inhalation - Rat [ppm] > 295 ppm Animal: rat, Guideline: OECD Guideline 403 (Acute Inhalation Toxicity)

Skin corrosion/irritation : Not classified
Additional information : Repeated exposure may cause skin dryness or cracking.
Serious eye damage/irritation : Not classified
Additional information : Based on available data, the classification criteria are not met
Respiratory or skin sensitisation : Not classified
Additional information : Based on available data, the classification criteria are not met
Germ cell mutagenicity : Not classified
Additional information : Based on available data, the classification criteria are not met
Carcinogenicity : Not classified
Additional information : Based on available data, the classification criteria are not met
Reproductive toxicity : Not classified
Additional information : Based on available data, the classification criteria are not met

Hydrocarbons, C11-14, n-alkanes, isoalkanes, cyclics, <2% aromatics (64742-47-8)

NOAEL (animal/male, F0/P) ≥ 3000 mg/kg bodyweight Animal: rat, Animal sex: male

STOT-single exposure : Not classified
Additional information : Based on available data, the classification criteria are not met

Xylene (1330-20-7)

STOT-single exposure May cause respiratory irritation.

STOT-repeated exposure : Not classified
Additional information : Based on available data, the classification criteria are not met

Xylene (1330-20-7)

LOAEL (oral, rat, 90 days) 150 mg/kg bodyweight Animal: rat, Animal sex: male, Guideline: OECD Guideline 408 (Repeated Dose 90-Day Oral Toxicity in Rodents), Guideline: EPA OPP 82-1 (90-Day Oral Toxicity)

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Hydrocarbons, C11-14, n-alkanes, isoalkanes, cyclics, <2% aromatics (64742-47-8)	
NOAEL (oral, rat, 90 days)	750 mg/kg bodyweight Animal: rat, Animal sex: female
NOAEC (inhalation, rat, vapour, 90 days)	≥ 0.024 mg/l air Animal: rat, Guideline: OECD Guideline 412 (Subacute Inhalation Toxicity: 28-Day Study)
2-pentanone oxime (623-40-5)	
NOAEC (inhalation, rat, gas, 90 days)	298.9 ppm Animal: rat, Guideline: OECD Guideline 412 (Subacute Inhalation Toxicity: 28-Day Study)
Aspiration hazard	: Not classified
Additional information	: Based on available data, the classification criteria are not met
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Viscosity, kinematic	> 20.5 mm²/s

11.2. Information on other hazards

11.2.1. Endocrine disrupting properties

No additional information available

11.2.2. Other information

Potential adverse human health effects and symptoms : Based on available data, the classification criteria are not met

SECTION 12: Ecological information

12.1. Toxicity

Hazardous to the aquatic environment, short-term (acute) : Not classified

Hazardous to the aquatic environment, long-term (chronic) : Not classified

Xylene (1330-20-7)	
LC50 - Fish [1]	2.6 mg/l Test organisms (species): Oncorhynchus mykiss (previous name: Salmo gairdneri)
EC50 - Crustacea [1]	> 3.4 mg/l Test organisms (species): Ceriodaphnia dubia
NOEC chronic fish	> 1.3 mg/l Test organisms (species): Oncorhynchus mykiss (previous name: Salmo gairdneri) Duration: '56 d'
2-pentanone oxime (623-40-5)	
EC50 72h - Algae [1]	≈ 54 mg/l Test organisms (species): Pseudokirchneriella subcapitata (previous names: Raphidocelis subcapitata, Selenastrum capricornutum)
EC50 72h - Algae [2]	88 mg/l Test organisms (species): Pseudokirchneriella subcapitata (previous names: Raphidocelis subcapitata, Selenastrum capricornutum)

12.2. Persistence and degradability

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Persistence and degradability : Not established.

12.3. Bioaccumulative potential

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Bioaccumulative potential : Not established.

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12.4. Mobility in soil

No additional information available

12.5. Results of PBT and vPvB assessment

No additional information available

12.6. Endocrine disrupting properties

No additional information available

12.7. Other adverse effects

Additional information : Avoid release to the environment.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Product/Packaging disposal recommendations : Dispose in a safe manner in accordance with local/national regulations.
Ecology - waste materials : Avoid release to the environment.

SECTION 14: Transport information

In accordance with ADR / IMDG / IATA / ADN

ADR	IMDG	IATA	ADN
14.1. UN number or ID number			
Not regulated	Not regulated	Not regulated	Not regulated
14.2. UN proper shipping name			
Not regulated	Not regulated	Not regulated	Not regulated
14.3. Transport hazard class(es)			
Not regulated	Not regulated	Not regulated	Not regulated
14.4. Packing group			
Not regulated	Not regulated	Not regulated	Not regulated
14.5. Environmental hazards			
Not regulated	Not regulated	Not regulated	Not regulated
No supplementary information available			

14.6. Special precautions for user

Overland transport

Not regulated

Transport by sea

Not regulated

Air transport

Not regulated

Inland waterway transport

Not regulated

14.7. Maritime transport in bulk according to IMO instruments

Not applicable

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SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

15.1.1. EU-Regulations

Contains no REACH substances with Annex XVII restrictions

Contains no substance on the REACH candidate list

Contains no REACH Annex XIV substances

Contains no substance subject to Regulation (EU) No 649/2012 of the European Parliament and of the Council of 4 July 2012 concerning the export and import of hazardous chemicals.

Contains no substance subject to Regulation (EU) No 2019/1021 of the European Parliament and of the Council of 20 June 2019 on persistent organic pollutants

Contains no substance subject to Regulation (EU) 2019/1148 of the European Parliament and of the Council of 20 June 2019 on the marketing and use of explosives precursors.

VOC content : < 0.1 %

15.1.2. National regulations

France	
Occupational diseases	
Code	Description
RG 4 BIS	Gastrointestinal disorders caused by benzene, toluene, xylenes and all products containing them
RG 84	Conditions caused by liquid organic solvents for professional use: saturated or unsaturated aliphatic or cyclic liquid hydrocarbons and mixtures thereof; liquid halogenated hydrocarbons; nitrated derivatives of aliphatic hydrocarbons; alcohols; glycols, glycol ethers; ketones; aldehydes; aliphatic and cyclic ethers, including tetrahydrofuran; esters; dimethylformamide and dimethylacetamide; acetonitrile and propionitrile; pyridine; dimethylsulfone and dimethylsulfoxide

Germany

Water hazard class (WGK) : WGK 3, Highly hazardous to water (Classification according to AwSV, Annex 1)

Hazardous Incident Ordinance (12. BImSchV) : Is not subject of the Hazardous Incident Ordinance (12. BImSchV)

Netherlands

SZW-lijst van kankerverwekkende stoffen : Hydrocarbons, C11-14, n-alkanes, isoalkanes, cyclics, <2% aromatics, HYDROCARBONS, C12-C16, ISOALKANES, CYCLICS, <2% AROMATICS are listed

SZW-lijst van mutagene stoffen : Hydrocarbons, C11-14, n-alkanes, isoalkanes, cyclics, <2% aromatics, HYDROCARBONS, C12-C16, ISOALKANES, CYCLICS, <2% AROMATICS are listed

SZW-lijst van reprotoxische stoffen – Borstvoeding : None of the components are listed

SZW-lijst van reprotoxische stoffen – Vruchtbaarheid : None of the components are listed

SZW-lijst van reprotoxische stoffen – Ontwikkeling : Xylene is listed

Switzerland

Swiss National Regulations : Article 13 Order on the protection of maternity (RS 822.111.52):
Pregnant women and breastfeeding mothers cannot come into contact with this product (this substance/this preparation) when working except where it has been established, on the basis of a risk analysis performed in accordance with Art. 63 OLT 1 (RS 822.111), that there is no concrete threat to the health of the mother or baby or that said threat can be excluded thanks to the suitable protection measures taken.
Article 4, subparagraph 4 Order on the protection of young workers (OLT 5, RS 822.115) and Article 1, letter f Order of the DEFR on dangerous works for young workers (822.115.2):
Young workers undergoing initial professional training cannot work with this product (this substance/this preparation) except where envisaged in the order of professional training to achieve the training purposes and if the training plan conditions and applicable age limits are respected. Young workers who do not undergo initial professional training cannot work with this product (this substance/this preparation). Workers of either sex aged under 18 years old are considered as young.

Storage class (LK) : LK 10/12 - Liquids

CH - VOC (SR 814.018) : 0.019417213444141 %

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United Kingdom / Australia / New Zealand

Other information

: This SDS is prepared in accordance with the model Code of Practice for the Preparation of Safety Data Sheets for Hazardous Chemicals, the product is not classified as dangerous.

Please read instructions / label before using product.

EMERGENCY CONTACTS

Jasco Pty Ltd : 02 9807 1555
Police and Fire Brigade : 000
Poisons information centre : 13 11 26
Safety Data Sheet applicable regions : Australia

This SDS is prepared in accordance with the model Code of Practice for the Preparation of Safety Data Sheets for Hazardous Chemicals, the product is not classified as dangerous. Supplied as permitted by New Zealand regulations; EPA Hazardous Substances (Safety Data Sheet) notice.

Please read instructions / label before using product.

EMERGENCY CONTACTS

Jasco Pty Ltd : 02 9807 1555
Poisons information centre : 0800 764 766 (0800 POISON)
Safety Data Sheet applicable regions : New Zealand.

15.2. Chemical safety assessment

No chemical safety assessment has been carried out

SECTION 16: Other information

Data sources

: REGULATION (EC) No 1272/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006.

Other information

: None.

Full text of H- and EUH-statements:	
Acute Tox. 4 (Dermal)	Acute toxicity (dermal), Category 4
Acute Tox. 4 (Inhalation)	Acute toxicity (inhal.), Category 4
Acute Tox. 4 (Oral)	Acute toxicity (oral), Category 4
Aquatic Chronic 3	Hazardous to the aquatic environment — Chronic Hazard, Category 3
Asp. Tox. 1	Aspiration hazard, Category 1
Eye Irrit. 2	Serious eye damage/eye irritation, Category 2
Flam. Liq. 3	Flammable liquids, Category 3
H226	Flammable liquid and vapour.
H302	Harmful if swallowed.
H304	May be fatal if swallowed and enters airways.
H312	Harmful in contact with skin.
H315	Causes skin irritation.
H319	Causes serious eye irritation.
H332	Harmful if inhaled.
H335	May cause respiratory irritation.
H412	Harmful to aquatic life with long lasting effects.
Skin Irrit. 2	Skin corrosion/irritation, Category 2

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Full text of H- and EUH-statements:

STOT SE 3	Specific target organ toxicity — Single exposure, Category 3, Respiratory tract irritation
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Safety Data Sheet (SDS), EU

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.