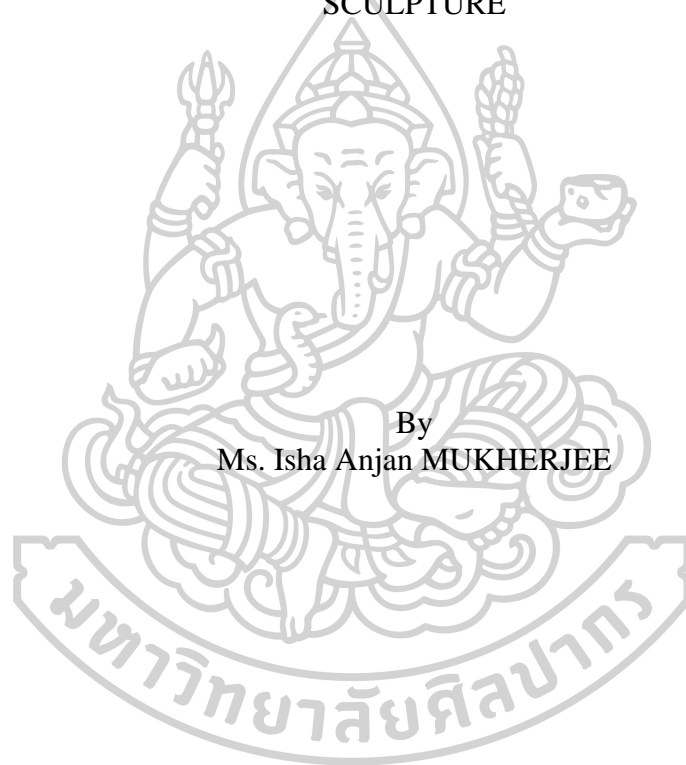




TEXTURED DOG BY THANATNOOND KUMPROMMARAT (2010),
SANAMCHANDRA ART GALLERY CONSERVATION OF A CERAMIC
SCULPTURE

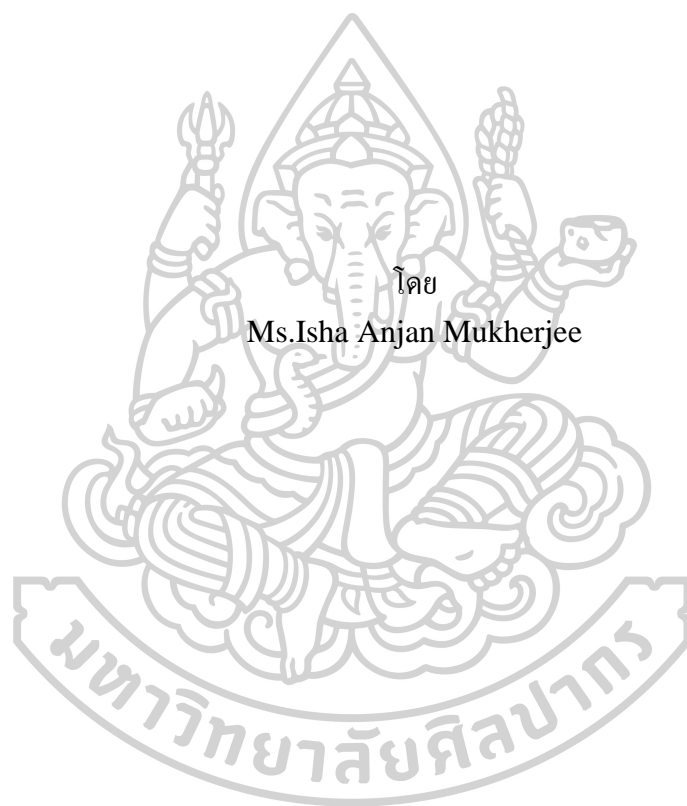


By
Ms. Isha Anjan MUKHERJEE

An Independent Study Submitted in Partial Fulfillment of the Requirements
for Master of Arts Cultural Heritage Conservation and Management (International
Program)

Silpakorn University
Academic Year 2025

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Ms.Isha Anjan Mukherjee

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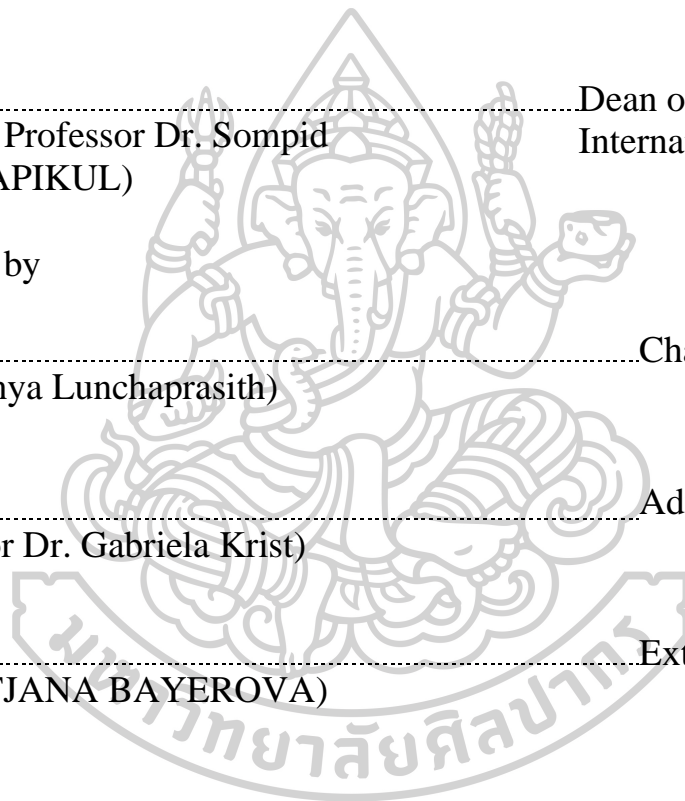
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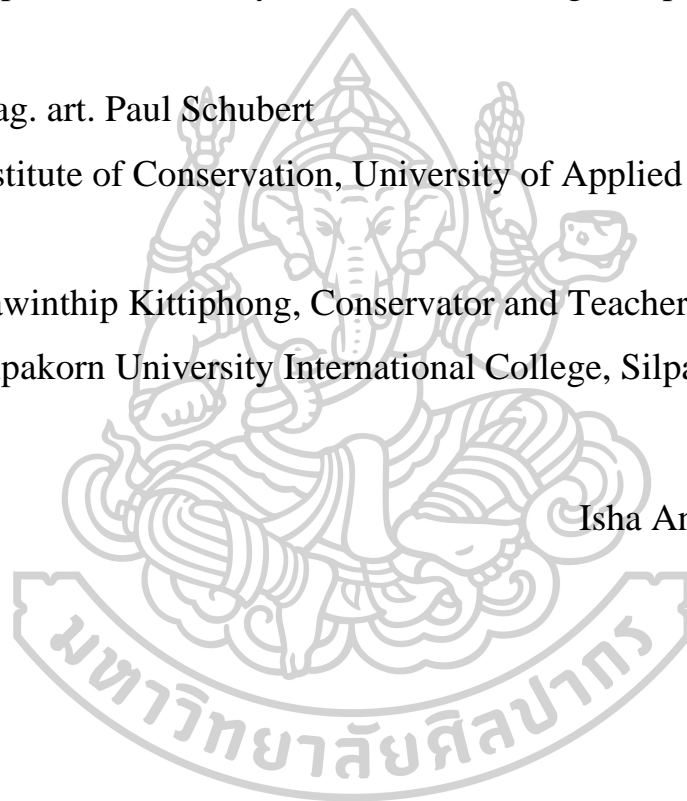


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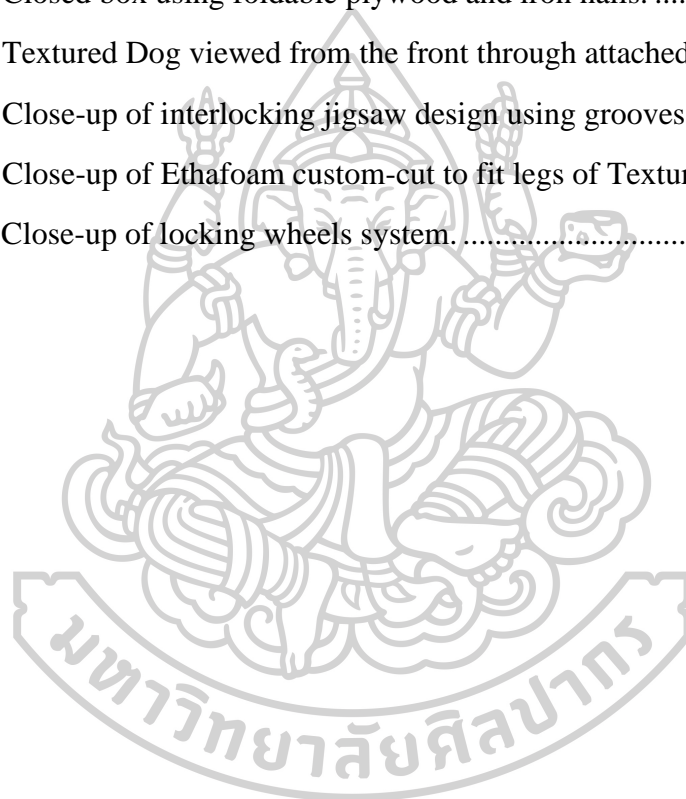


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Introduction

This master thesis presents the conservation treatment of *Textured Dog* (2010), a glazed stoneware sculpture created by Thai ceramic artist Thanatnoond Kumprommarat. The sculpture is part of a series of eight dog-shaped lounge chairs and is currently housed at the Sanamchandra Art Gallery in Bangkok, Thailand. Integrating traditional ceramic techniques with contemporary aesthetics, the work challenges conventional boundaries between functional design and sculptural installation. The artist's material and conceptual choices reflect the heritage of Ratchaburi, a province renowned for its historic role in ceramic production.

The purpose of this study is to examine the material composition, deterioration patterns, and conservation needs of the broken black-and-white sculpture from the *Textured Dog* installation. Having been displayed outdoors for over a decade without prior maintenance and conservation intervention, the sculpture exhibits advanced structural breakage due to an unknown incident, surface soiling, flaking glaze, and biological growth. This thesis aims to develop and implement a conservation strategy that restores the object's structural stability, ensures respect for the artist's intent, and supports long-term preservation. Scientific analyses, including optical microscopy and SEM-EDS, are employed to guide material-sensitive treatment decisions.

This research is conducted as part of the Joint Master's Programme in Cultural Heritage Conservation and Management, a joint degree offered by the University of Applied Arts, Vienna, Austria, and Silpakorn University International College, Bangkok, Thailand. It is supervised by Univ.-Prof. Dr. Gabriela Krist and co-supervised by Dr. Thanya Lunchaprasith.

Chapter 1 introduces the artist and his *Textured Dog* installation, his connection to Ratchaburi's ceramic community, and the broader context of ceramic arts in Thailand. Chapter 2 presents the technological and scientific examination of the object's materials and manufacture. Chapter 3 outlines the condition assessment, documenting forms of deterioration and their probable causes. Chapter 4 details the conservation testing and treatments undertaken, with a discussion on materials, techniques, and ethical considerations. The conclusion reflects on the implications of this case study for future conservation of the whole ensemble and contemporary ceramic artworks in tropical environments.

The scope of this thesis is intentionally focused. It does not extend to the conservation of the remaining seven dog sculptures in the *Textured Dog* installation, nor does it undertake a comprehensive art historical interpretation of Thanatnoond Kumprommarat's other works. The study concentrates on the technical and material

conservation of one damaged sculpture, offering a practical model for conservation under comparable environmental and institutional conditions.

By combining scientific inquiry with applied conservation methods, this thesis contributes to the body of knowledge surrounding ceramic conservation in Southeast Asia. A custom-made transportation and storage box has also been developed as part of the conservation project, specifically designed to support the sculpture's weight and shape during transit and long-term storage. This protective housing ensures safe relocation to the Sanamchandra Art Gallery, while also serving as a preventive measure until its future reinstallation in a dedicated exhibition space.



1. Art Historical Background

This chapter provides an overview of the historical and cultural context surrounding "Textured Dog," a ceramic installation by Thai artist Thanatnoond Kumprommarat, created in 2010. Through an exploration of the artist's background, his creative philosophy, and the regional ceramic traditions of Ratchaburi, the chapter situates the artwork within both its contemporary and cultural framework. It also highlights the significance of the installation within the broader narrative of Thai ceramic art and community-based artistic practices. The aim is to establish a foundational understanding of the object's origin, significance, and the environment from which it emerged, thereby informing the conservation approach undertaken in subsequent chapters.

1.1 About the Artist: Thanatnoond Kumprommarat

Thanatnoond Kumprommarat (b. May 1, 1982) is a contemporary Thai ceramic artist whose work is characterised by an innovative fusion of functional design, childlike spontaneity, and social commentary (Fig. 1). He is best known for *Textured Dog*, an award-winning ceramic installation that exemplifies his ability to reimagine everyday objects into interactive sculptural forms. Thanatnoond's artistic vision is rooted in the cultural and material traditions of Thailand, particularly those of Ratchaburi province, which has played a defining role in shaping his creative direction.



Figure 1: Thanatnoond Kumprommarat, artist portrait.

Thanatnoond's formal training began at King Mongkut's University of Technology, North Phra Nakhon, where he pursued a degree in Architecture with a specialisation in Sculpture Design. His interdisciplinary education laid the foundation for his interest in structure, scale, and form. Qualities that would later define his ceramic practice. Following graduation, a visit to Ratchaburi proved pivotal. Drawn to the province's longstanding ceramic heritage and its vibrant, close-knit art community, Thanatnoond decided to establish his career in the region. He took up his first professional position as a designer in Ratchaburi and continues to live and work there, integrating himself into the local artistic and cultural fabric. In a personal interview, he shared that Ratchaburi's blend of artisanal tradition and community-driven art initiatives strongly aligned with his own values and artistic aspirations. He expressed a particular admiration for how art in the region was deeply embedded in everyday life, a quality that he strived to replicate through his work.¹

¹ Kumprommarat, Thanatnoond. 2025. Interview by Isha A Mukherjee. January 10, via Line video call. Translation by Kawinthip Kittiphong.

In addition to *Textured Dog*, Thanatnoond has produced many significant public artworks that reflect his commitment to social and community-based artistic practice. The artist's profound connection to Ratchaburi is evident in his works, prominently displayed throughout the province. One such work is *Selfie* (Fig. 2), a public installation located at the Ratchaburi Railway Station. This series of tall ceramic human-like figures is arranged in a row, inviting viewers to reflect on the theme of presence and individuality in public spaces. The work illustrates the artist's continuous exploration of how ceramic objects can provoke interaction and contemplation within everyday environments.



Figure 2 : *Selfie* by Thanatnoond Kumprommarat at Ratchaburi Railway Station. 2012.

Another important project is Thanatnoond's involvement in the *Graffiti Cat Town Series Project* on Saridet Road in Ratchaburi. As part of a collective of local artists known as "Jartown," Thanatnoond contributed to a series of cat-themed graffiti (Fig. 3) created by various artists from the community that transforms an urban alleyway into a vivid and emotionally charged public art space. The site, known for being a place where abandoned pets are often left and where vehicles pass at high speeds, became the canvas for colourful and stylised depictions of cats and dogs. The intention behind the project was to raise awareness about animal abandonment and to foster a culture of empathy and responsibility within the local community (Puaphongkorn 2018). This initiative highlights the artist's dedication not only to public engagement but also to social impact.



Figure 3 : *Cat with blue eyewear and the pink dog graffiti* by Thanatnoond Kumprommarat. 2011.

Throughout his body of work, Thanatnoond Kumprommarat emerges as a key figure in Thailand's evolving ceramic landscape. His practice exemplifies a dialogue between traditional craftsmanship and contemporary issues, all while maintaining a strong connection to local materials, environments, and audiences. By incorporating playfulness, cultural references, and public accessibility, Thanatnoond challenges the boundaries of ceramic art and redefines how it can function within both the artistic canon and everyday life.

1.2. Description of the Artwork: Textured Dog

The installation titled *Textured Dog* (Thai: พมลาช, *Pi Lam*), completed in 2010 by Thanatnoond Kumprommarat, is among the artist's most celebrated works (Fig. 4). Conceptually and materially rooted in Thai street culture and ceramic tradition, the installation presents a striking reinterpretation of everyday life through the medium of clay. The artwork consists of a set of eight ceramic sculptures, each designed in the form of a life-sized dog that also functions as a lounge chair for children. Measuring 80 cm in height, 30 cm in width, and 66 cm in length, each sculpture weighs 60 kilograms. The sculptures deliberately reference the sturdy build of the standard plastic chairs that inspired the installation.



Figure 4 : *Textured Dog Installation outside Sanamchandra Gallery.*

Each dog sculpture is painted in bold, horizontal stripes with a distinct colour palette, three in black-and-white, and one each in red-and-white, orange-and-white, yellow-and-white, green-and-white, and light-blue-and-white. Their simplified geometric forms, including upright ears, cylindrical snouts, and round eyes, evoke a playful yet structured aesthetic (Fig. 5). Positioned on all fours, the dogs face in various directions: four forward, two backward, one upward, and one downward. Their tails alternate in orientation, with four curving upwards and four downwards. This variation in posture and direction introduces a dynamic visual rhythm and sense of interaction within the group. Initially installed in an outdoor setting, the sculptures were exposed to prolonged weathering from fluctuating climatic conditions. These environmental conditions contributed to surface wear and deterioration over time, gradually compromising both their aesthetic appearance and structural integrity.



Figure 5 : *Textured Dog Installation.*

The title *หมาลาย* (*Pi Lam*) itself carries a playful linguistic duality that reveals the artist's clever engagement with the Thai language and tone. While *หมา* (*hma*) translates to “dog” and *ลาย* (*lai*) to “pattern” or “striped,” the phonetic similarity to *ม้าลาย* (*mha lai*), meaning “zebra,” introduces an element of wordplay that blurs meaning and evokes curiosity. This subtle manipulation of language adds a conceptual layer to the work, engaging Thai-speaking viewers in a culturally specific, multisensory experience that transcends mere visual appreciation.

At the heart of the installation lies the artist's reinterpretation of the ubiquitous plastic chairs commonly found across Southeast Asia, in markets, roadside food stalls, and outdoor communal spaces, which enable life to unfold outside the four walls of a building (Fig. 6) (Hilton 2017). Thanatnoond elevates these functional objects into the realm of fine art by reimagining them as stylised dogs, thus anthropomorphising an inanimate object into a friendly, approachable form. This transformation reflects the artist's core philosophy: art should be accessible, interactive, and intimately tied to daily life.



Figure 6: Man eating at a street-side restaurant in Bangkok's Chinatown.

The ceramic dogs are constructed using clay sourced locally from Ratchaburi, a province renowned for its high-quality clay and rich ceramic heritage. Each sculpture is finished with a low-fired clear glaze at 1,080°C, a temperature that allows for durability, commonly used in stoneware techniques, while preserving the clay's natural texture. Rather than pursuing a refined, uniform surface, Thanatnoond deliberately employs an uneven, expressive glazing technique inspired by how young children spontaneously draw on walls or furniture at home. The resulting surfaces are whimsical and erratic, embodying a childlike innocence that contributes to the work's playful tone. These glazing patterns appear gestural and emotionally intuitive, mirroring the aesthetic of youthful mark-making and reinforcing the installation's appeal to a younger audience.

This intentional embrace of imperfection further challenges the traditional expectations of ceramic craftsmanship, where symmetry, polish, and precision are often prioritised. By choosing to mimic the visual language of children and street culture, Thanatnoond injects informality and approachability into his work, making it both physically engaging and emotionally resonant.

The installation was first presented at the 15th National Ceramic Exhibition in 2010, where it received the Outstanding Industry Model award. The exhibition's guidelines limited the artist to producing only eight pieces, though additional iterations of the

lounge chair were conceptualised. The recognition accentuated the work's innovative balance of artistic imagination, craftsmanship, and functional design.

Textured Dog not only showcases the artist's technical skills and conceptual sophistication but also serves as a critical commentary on the fluid boundaries between art and design, public and private space, and tradition and modernity. It invites children to sit, climb, and interact, thus disrupting the conventional expectation of passive viewing in a gallery or a museum setting. In doing so, the installation transforms the viewer into a participant, thereby bridging the gap between the object and the audience.

Ultimately, the work stands as a vivid example of how contemporary Thai ceramic art is evolving: rooted in material heritage, yet unafraid to experiment with form, humour, and function. Through *Textured Dog*, Thanatnood Kumprommarat offers a compelling model of how ceramics can serve as a medium of cultural storytelling, social engagement, and playful reimagination.

1.3. Ratchaburi – The Hub of Ceramics

Thailand has a long history of stoneware production, dating back to the Sukhothai and Sawankhalok periods, with influences from Chinese and Southeast Asian pottery traditions (Miksic and Goh 2017). These ceramics were valued for their durability and aesthetic appeal, serving both functional and decorative purposes in the past (Hein 2001). Over time, variations in clay composition, firing methods, and glazing techniques evolved, with Ratchaburi becoming a major centre for stoneware production due to its rich clay resources and traditional kiln technology (Phuthorn 2015). These ancient methods and techniques had such a lasting impact that they are still utilised in contemporary ceramics and continue to be practised today.

Ratchaburi Province, located 80 kilometres west of Bangkok, has established itself as one of Thailand's leading locations for ceramic production and artistic expression, colloquially referred to as "Art-Chaburi." The region's cultural identity is closely tied to its ceramic legacy, which blends historical craftsmanship with contemporary innovation. Established as a key production site during the reign of King Rama VI, Ratchaburi's abundant natural clay resources, especially those found along the banks of the Mae Klong River, have made it an ideal location for pottery and ceramic industries (Sopon, n.d.).



Figure 7: Dragon jar in the making.

One of the province's most recognisable contributions to Thai ceramic heritage is the *ong jad nam* or dragon jars (Fig. 7). These jars are large, hand-crafted water storage vessels adorned with intricate dragon motifs and were initially produced using techniques introduced by Chinese immigrant potters in the early twentieth century. These artisans adapted their knowledge to local materials and kiln conditions, laying the foundation for the region's distinctive ceramic industry (Tao Hong Tai Ceramics 2003).

The province's ceramic industry has matured over several decades, with local artisans mastering techniques that have been passed down through generations. The unique clay found in Ratchaburi contributes significantly to the exceptional quality of ceramics produced in the area. Ratchaburi's ceramics industry relies on a variety of clay types. ดินดำ Black clay (*din dum*), rich in iron, turns dark grey or black in reduction firing and is commonly used for creating durable water jars (Tingley 1999). However, in more recent times, black clay can be well-suited for creating sturdy and detailed moulds. The use of these moulds made from black clay is frequently employed by contemporary artists in the region for both functional and sculptural purposes within modern ceramic practices. ดินกรอบ Biscuit clay (*din krob*), a buff-coloured porous clay, is suitable for both unglazed and glazed stoneware, and is commonly used for water jars (Miksic and Goh 2017). ดินขาว White clay (*din khao*), high in kaolinite, is ideal for high-fired ceramics and celadon glazing due to its smooth texture and finish (Tingley 1999).

Ratchaburi's commitment to ceramics extends beyond production. It has actively embraced its identity as a national ceramics hub through exhibitions, educational initiatives, and cultural events. One of the most prominent of these is the National Ceramic Exhibition, which showcases works by local artists and promotes the ongoing evolution of ceramic art in Thailand (Sopon n.d.). The province also hosts a network of galleries, museums, and studios that attract both practitioners and collectors, as well as tourists from across the globe.

In summary, Ratchaburi's enduring legacy in ceramic production provides not only the material and technical foundation but also the cultural environment that fosters works like *Textured Dog*. Through a seamless integration of tradition and innovation, the province continues to shape the trajectory of Thai ceramic art. Kumprommarat's installation stands as a testament to this unique artistic ecosystem, one where heritage is not merely preserved but actively reimagined.

1.4. Tao Hong Tai Ceramic Factory

The Tao Hong Tai Ceramic Factory is a third-generation family enterprise that has played a foundational role in establishing Ratchaburi as a national and international centre for ceramic production. Its origins can be traced back to the 1930s, when Chinese immigrants brought ceramic craftsmanship to Thailand during the tutelage period. In 1933, Tia Song Hong and Er Jer Ming founded the Tao Seng Lee Ceramic Factory in Ratchaburi, producing what is believed to be Thailand's first *ong jad nam*, or dragon jars, using locally sourced clay. By 1954, Tia Song Hong formally established Tao Hong Tai, which continued the production of these iconic water jars while expanding its operations to meet increasing demand (Tao Hong Tai Ceramics 2003).

The factory experienced a significant transformation in the latter half of the 20th century. In response to the decline in ceramic demand caused by the rise of plastic products in the 1960s and 1970s, the second generation, led by Chairat and Chanchai Supanichvoraparch, strategically modernised operations by acquiring advanced kilns and diversifying the product range. This adaptation allowed the factory to expand into international markets, exporting to regions including Europe, North America, and Australia. By the early 2000s, the third generation represented by Pongsak and Wasinburee Supanichvoraparch, further elevated the factory's profile by initiating collaborations with contemporary artists, introducing new techniques, and establishing Tao Hong Tai as a destination for cultural tourism (Fig. 8). Visitors today can witness the production process firsthand and explore curated exhibitions that bridge traditional ceramic production with contemporary artistic narratives. Currently, the Tao Hong Tai name is associated with over 59 ceramic-related enterprises, highlighting its expansive influence in the region.



Figure 8 : Wasinburee Supanichvoraparch, third-generation heir and contemporary ceramic artist at Tao Hong Tai Ceramic Factory.

Although *Textured Dog* was not produced at the Tao Hong Tai Ceramic Factory, it reflects the broader artistic environment the factory has helped cultivate. By promoting innovation alongside tradition, the factory has played a key role in shaping Ratchaburi's standing in the world.

1.5. Tao Hong Tai: D Kunst Gallery

Tao Hong Tai: D Kunst Gallery, established by Wasinburee Supanichvoraparch, has contributed meaningfully to the cultural development of Ratchaburi by expanding public engagement with contemporary art. The gallery is housed in a 100-year-old, three-story wooden building, and functions as a space for experimental and cross-disciplinary practices, encouraging artists to challenge traditional definitions of medium and audience (Tourism Thailand 2020). Its inclusive programming and emphasis on community access reflect the same values embodied in *Textured Dog*, particularly its shared commitment to blurring the lines between functional object, sculpture, and public art. Though the installation was not shown at this particular gallery, its spirit aligns closely with the type of work the space supports.

1.6. Silpakorn Art Centre

The Silpakorn University Art Centre, based at the university's Wang Tha Phra campus in Bangkok, plays a pivotal role in Thailand's artistic and academic landscape. As an institutional hub for exhibitions, research, and cultural programming, it contributes significantly to the development and dissemination of Thai visual arts (Silpakorn University Art Centre n.d.). A distinctive feature of the Centre is its Visible Storage initiative, located at the Sanamchandra campus in Nakhon Pathom (Fig. 9). This public-facing repository makes portions of the university's extensive and diverse collection accessible for viewing and study, reflecting a commitment to both preservation and educational outreach.



Figure 9 : Visitors observing artworks at the Visible Storage Gallery, Art Centre, Silpakorn University, Bangkok.

The collection itself includes works by Silpakorn University faculty, students, alumni, and award recipients from major national competitions such as the National Ceramic Exhibition and the Exhibition of Contemporary Art by Young Artists. Spanning a wide range of media, including painting, sculpture, printmaking, and mixed media, the collection embodies the dual mission of honouring Thailand's artistic heritage while fostering experimentation and contemporary practice.

Within this context, the inclusion of *Textured Dog* highlights the university's recognition of ceramics as a medium of conceptual relevance. Its presence in the Visible Storage's art collection underscores the installation's importance not only as a creative

work but also as a research asset, further affirming its position within the evolving discourse of Thai contemporary art.

1.7. National Ceramic Exhibition

The National Ceramic Exhibition, organised biennially by Silpakorn University since 1986, has become a key platform for showcasing ceramic art in Thailand. Initially established to support the nation's ceramic export industry, the exhibition has expanded its scope over time to promote artistic excellence, innovation, and education in the field of ceramics. It brings together both emerging and established artists, providing them with the opportunity to present their work to a broader audience at the Art Centre on the university's Wang Tha Phra campus in Bangkok (National Ceramic Exhibition 2014).

Beyond its exhibition function, the event plays a strategic role in elevating the status of ceramics within the Thai art community. It encourages conceptual development, technical experimentation, and public engagement while simultaneously benefiting tourism, the creative economy, and cultural preservation. Through curated displays and award recognition, the exhibition promotes a deeper appreciation for the aesthetic and artistic value of Thai ceramics. It contributes to the formation of a socially informed and forward-thinking ceramic discourse.

The recognition of *Textured Dog* at the 15th edition of the exhibition reflects this curatorial evolution (Fig. 10). The installation's focus on interactivity, materiality, and cultural commentary aligns with the exhibition's growing emphasis on works that are both contextually grounded and socially resonant. Its

inclusion affirms the National Ceramic Exhibition's role not only in promoting craftsmanship but also in legitimising ceramic art as a vital contributor to contemporary



Figure 10 : Excerpt from the award announcement featured in *Contemporary Ceramics: National Ceramic Exhibition*.

2. Technological Survey

FACT SHEET

Inv. Nr.:	N/A
Artist:	Thanatnoond Kumprommarat
Title/Description:	Textured Dog
Description:	Lounge chair, 1 of 8 set
Type:	Stoneware Clay Technique, low transparent coating, 1,080°C
Technique:	Pottery
Dimensions:	80 x 30 x 66 cm (each)
Dating:	2010
Provenance:	Ratchaburi, Thailand
Owner:	Silpakorn University Art Centre



Figure 11 : Textured Dog's body.
1 of 8, 80 x 30 x 66 cm.

This study examines the material composition and technological aspects of the glazed stoneware, *Textured Dog* by Thanatnoond, housed at the Sanamchandra Art Gallery, which falls under the umbrella of Silpakorn University Art Centre. The primary objective of the analysis is to characterise the composition of the stoneware body and glaze, assess the technological choices made during its manufacturing process, and understand the implications for further conservation and preservation. The findings presented here are based on visual inspections and the laboratory examination of three sample fragments collected from the sculpture.

Samples were collected systematically to ensure accurate material analysis. Three samples were taken from different parts of the sculpture to provide insights into both the core ceramic body and the glaze composition – I1/ 3020: Broken stoneware fragments from the inner body; I2/ 3021: Unglazed stoneware fragments from underneath the body; I3/ 3022: Loose glaze fragments (Fig. 12, 13, and 14).²

² The investigations were carried out by Dr. Tatjana Bayerova and Dr. Farkas Pinter at the Institute of Conservation, University of Applied Arts Vienna, under the supervision of o.Univ.-Prof. Mag. Dr. Gabriela Krist.



Figure 12 : Broken stoneware from the inner body. Sample i1/3020 (see red arrow).



Figure 13 : Unglazed clay structure from underneath the body. Sample i2/3021 (see red arrow).



Figure 14 : Loose glaze fragments. Sample i3/3022. (See red rectangle).

To facilitate precise material characterisation, the samples were created using a standardised preparation methodology. Each sample was embedded in epoxy resin (Araldite® 2020) to stabilise the material for cross-sectioning. The embedded samples were dry ground using various sanding sheets of different grades and polished to obtain a smooth surface for microscopic examination. Carbon coating was applied to the samples before SEM-EDS analysis to enhance conductivity and improve imaging accuracy.³

To achieve a detailed understanding of the material composition and the microstructure of the sculpture, multiple scientific techniques were employed. Optical microscopy incident light⁴ was used to examine the microstructure features of the three samples provided, particularly the texture, porosity, and any surface treatments present on the ceramic body. Scanning Electron Microscopy with Energy Dispersive X Ray Analysis (SEM-EDS)⁵ enabled high-resolution imaging and elemental composition analysis of

³ The investigations were carried out by Dr. Tatjana Bayerova and Dr. Farkas Pinter at the Institute of Conservation, University of Applied Arts Vienna.

⁴ The investigations were carried out by Dr. Tatjana Bayerova and Dr. Farkas Pinter at the Institute of Conservation, University of Applied Arts Vienna.

⁵ The investigations were carried out by Dr. Tatjana Bayerova and Dr. Farkas Pinter at the Institute of Conservation, University of Applied Arts Vienna.

both the stoneware and the glaze. This technique was crucial for identifying the presence of specific oxides and mineral components.

2.1. Ceramic Body – Stoneware

2.1.1. Black clay

The insights provided by Mr. Thanatnoond during the interview closely aligned with the results of the analytical study of *Textured Dog*. According to the artist, the first step in creating the sculpture involved using black clay to form the mould, which was fired at 800°C to solidify.⁶

The high iron content in black clay contributes to its durability and strength, and thermal shock resistance, an essential property for moulds that undergo multiple firings (Phuthorn 2015). This resistance helps to prevent cracking or breakage during the firing process, ensuring the reliability of the mould throughout the ceramic production. The firing process of the black clay typically occurs at temperatures ranging from 800°C to 1000°C during the initial mould firing, which aligns with the artist's description of the process. This relatively low firing temperature contributes to the solidification of the clay, resulting in the creation of a strong and durable mould suitable for subsequent stages in ceramic production.

2.1.2. Biscuit clay

Once the mould was completed and dried, biscuit clay was applied as the base material to form the entire shape of the dog within the mould. After the dog shape was formed, it was re-fired and removed from the mould.⁷

The results of the base material analysis conducted in the study correlated with the information provided by the artist describing the creation of his art installation. Light microscopy of the cross-sections was conducted, and the analysis revealed that the base materials consisted of a light beige, kaolinitic clay matrix (Fig. 15), which is



Figure 15 : Micrograph of clay body cross-section.

classified as stoneware due to its dense, non-porous structure and high firing temperature. Scanning Electron Microscopy (SEM), coupled with Energy Dispersive X-ray Spectroscopy (EDS) analysis confirmed the

⁶ Kumprommarat, Thanatnoond. 2025. Interview by Isha A Mukherjee. January 10, via Line video call. Translation by Kawinthip Kittiphong.

⁷ Kumprommarat, Thanatnoond. 2025. Interview by Isha A Mukherjee. January 10, via Line video call. Translation by Kawinthip Kittiphong.

primary presence of silicon (Si), aluminium (Al), potassium (K), and iron (Fe), which are all elements typically found in stoneware ceramics.⁸

The composition of the body reveals the presence of kaolinitic clay, quartz, feldspar, and aluminosilicates, which contribute to its strength, durability, and vitrification properties. The presence of kaolinite ($\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$) suggests a refined clay source providing plasticity during shaping and a stable matrix upon firing. Quartz (SiO_2), serving as a filler material, reduces shrinkage and enhances mechanical strength. At the same time, feldspar ($\text{KAlSi}_3\text{O}_8 - \text{NaAlSi}_3\text{O}_8 - \text{CaAl}_2\text{Si}_2\text{O}_8$) acts as a flux⁹, lowering the melting point and promoting partial vitrification, which improves the ceramic's density and translucency.

As mentioned previously, a detailed microstructural analysis of the ceramic body, conducted using visible reflected light microscopy, revealed a light beige kaolinitic clay matrix beneath a white glaze layer. Embedded within the matrix were inclusions of quartz and feldspar grains, ranging between 100 and 200 μm in size, indicating the intentional addition of tempering materials to enhance structural integrity and thermal shock resistance (Fig. 15, numbered 1). The body exhibited moderate porosity with irregularly distributed voids and shrinkage cracks parallel to the surface, likely the result of prolonged outdoor exposure.

Minor traces of iron oxides (Fe_2O_3) and titanium oxides (TiO_2) were also detected, contributing to the colour variations observed in the fired body (Fig. 15, numbered 1), which ranged from light beige to buff or reddish-brown hues, depending on the firing conditions.¹⁰ This overall composition aligns with the traditional stoneware formulations found in historical ceramics from Southeast Asia, particularly those produced in Thailand, where locally available raw materials exhibit a similar mineralogical profile. The high alumina-silicate content further supports the suitability of the ceramic body for high-fired applications, ensuring a durable and resilient final product as seen in the *Textured Dog*.

⁸ The investigations were carried out by Dr. Tatjana Bayerova and Dr. Farkas Pinter at the Institute of Conservation, University of Applied Arts Vienna.

⁹ Flux – A fluxing agent (or softening agent) is required to lower the sintering temperature and save energy during firing in the powder sintering method. Feldspars are used as fluxing agents to form a glassy phase at lower temperatures and as a source of alkalis and alumina in glazes (Buys and Oakley 1996).

¹⁰ The investigations were carried out by Dr. Tatjana Bayerova and Dr. Farkas Pinter at the Institute of Conservation, University of Applied Arts Vienna.

2.2. White slip

The second step in the process involved applying a white clay as a slip layer across the entire surface of each dog. ¹¹ The presence of the white slip layer was accurately noted in the SEM-BSE analysis results (Fig. 16). ¹² The layer consisted primarily of finely ground silica and feldspar. This layer served as a preparatory surface before the glaze application, ensuring better adhesion and enhancing the visual qualities of the final glazed surface. The mineralogical composition suggests that the stoneware was subjected to firing at a temperature of approximately 1080 - 1120°C, which is a characteristic of the lower side of mid-fired stoneware (Rado 1988).

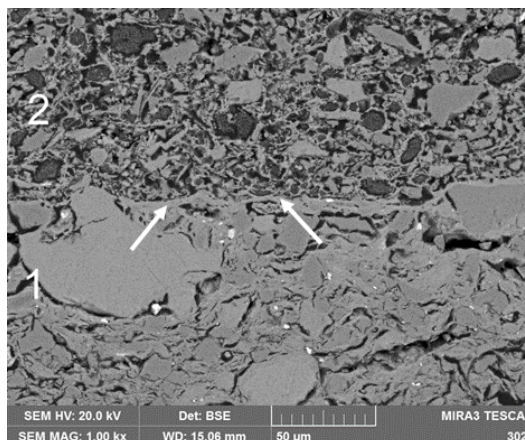


Figure 16 : SEM-BSE micrograph (1,000x): White arrows indicate location of white slip.

2.3. Glaze

The information provided by Thanatnoond about the production process stated that a black and transparent glaze was applied alternately in certain areas to create a painted zebra-like design. The piece was then fired for a final time at approximately 1100°C. During the final firing, cracks formed within the glaze layer, which were intentionally created to replicate the effect of celadon glaze on the surface (Fig. 17).¹³ SEM-EDS analysis of the fragments (Sample i3/3022) revealed two distinct glaze types applied to the sculpture, corresponding with the artist's described technique.¹⁴

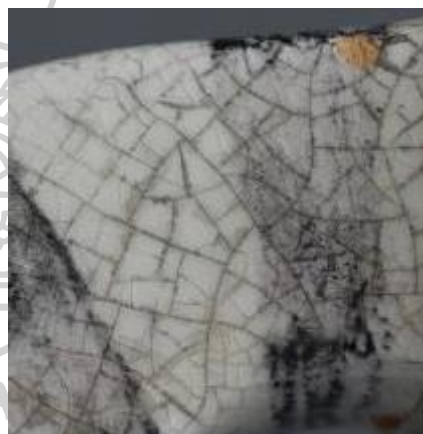


Figure 17 : Close-up of intentional Celadon cracks.

Celadon ceramics are typically classified as mid-fired stoneware. The distinctive green to blue hues of celadon glazes are most common. However, colors such as white, beige,

¹¹ Kumprommarat, Thanatnoond. 2025. Interview by Isha A Mukherjee. January 10, via Line video call. Translation by Kawinthip Kittiphong.

¹² The investigations were carried out by Dr. Tatjana Bayerova and Dr. Farkas Pinter at the Institute of Conservation, University of Applied Arts Vienna.

¹³ Kumprommarat, Thanatnoond. 2025. Interview by Isha A Mukherjee. January 10, via Line video call. Translation by Kawinthip Kittiphong.

¹⁴ The investigations were carried out by Dr. Tatjana Bayerova and Dr. Farkas Pinter at the Institute of Conservation, University of Applied Arts Vienna.

and cream are generally achieved through firing at temperatures ranging from 1180 to 1250°C in a reducing atmosphere. This temperature range places celadon within the mid-to-high-fired stoneware category.

In the case of *Textured Dog*, the firing temperature is measured between 1080 and 1120°C, which is slightly lower than traditional celadon firing but remains consistent with mid-fire stoneware methods (Gao, Zhang, and Cheng 2021). The ceramic body, composed of kaolinitic clay, feldspar, and quartz, aligns with materials commonly used in stoneware production. However, despite the material similarities, the glaze chemistry of the sculpture differs from traditional celadon, indicating a variation in glaze composition and technique adapted by the artist.

2.3.1. Transparent glaze

The transparent glaze over the white slip was analysed using SEM-EDS¹⁵ and identified as lime-alkaline glaze (Fig.18), consisting of Si, Al, Ca, Na, K, Zn, and Mg. The presence of zinc oxide (ZnO) is particularly significant, as it contributes to the clarity and durability of the glaze. The glaze exhibited a uniform thickness with minimal crazing, suggesting a controlled cooling during the firing process.

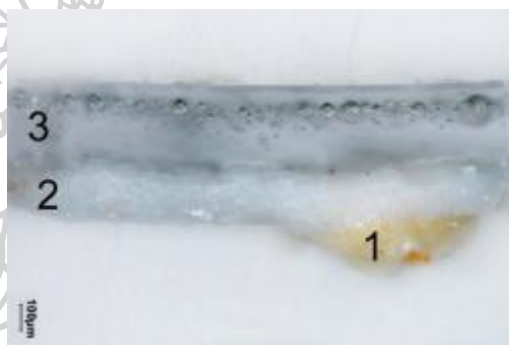


Figure 18 : SEM-EDS micrograph showing transparent lime glaze layer.

2.3.2. Black glaze

According to the SEM-EDS analysis¹⁶ the black glaze contains iron (Fe), chromium (Cr), zinc (Zn), and nickel (Ni), indicating the use of a spinel-type black pigment (Fig. 19, red arrow). This pigment is a chemically stable, high-temperature-resistant ceramic colourant, commonly produced through the combination of Fe, Cr, and Ni oxides in a zinc-rich matrix.



Figure 19 : SEM-EDS showing black glaze pigment (red arrow) and green biological growth.

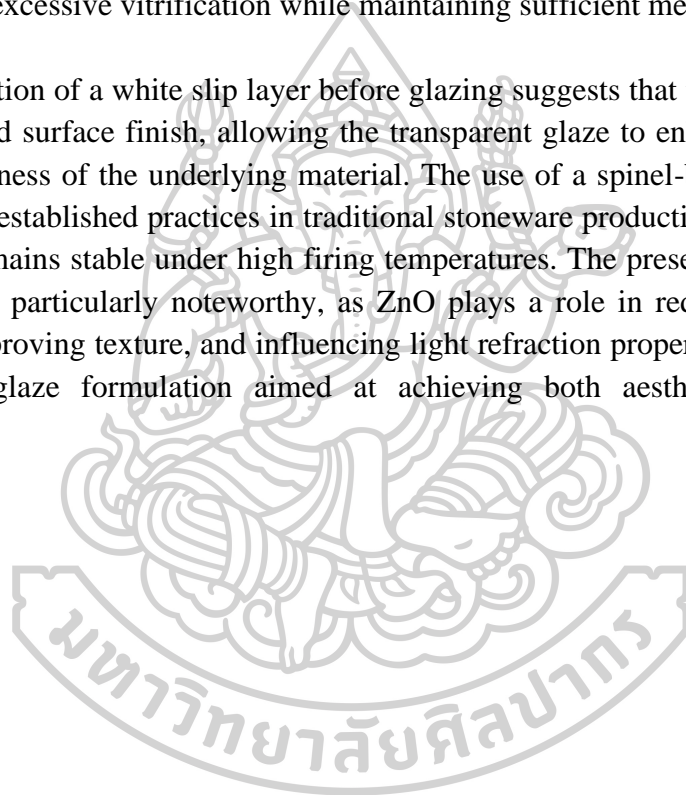
¹⁵ The investigations were carried out by Dr. Tatjana Bayerova and Dr. Farkas Pinter at the Institute of Conservation, University of Applied Arts Vienna.

¹⁶ The investigations were carried out by Dr. Tatjana Bayerova and Dr. Farkas Pinter at the Institute of Conservation, University of Applied Arts Vienna.

The presence of these elements suggests that the glaze formulation was carefully engineered to achieve a deep black colouration without excessive glossiness. Additionally, greenish discolouration at the bottom of the glaze layer was detected, likely due to the microbiological growth (algae colonisation) on the surface of the sculpture due to prolonged outdoor exposure (Fig. 19, numbered 2, green).

The findings suggest a well-considered ceramic manufacturing process. The presence of kaolinitic clay in the stoneware body, combined with added feldspar and quartz, indicates an intentional effort to balance workability and firing stability. The firing temperature appears to be controlled within the mid-range stoneware spectrum, preventing excessive vitrification while maintaining sufficient mechanical strength.

The application of a white slip layer before glazing suggests that the artist aimed for a more refined surface finish, allowing the transparent glaze to enhance the brightness and smoothness of the underlying material. The use of a spinel-based black pigment aligns with established practices in traditional stoneware production, ensuring that the pigment remains stable under high firing temperatures. The presence of zinc oxide in the glaze is particularly noteworthy, as ZnO plays a role in reducing glaze surface defects, improving texture, and influencing light refraction properties. This suggests a deliberate glaze formulation aimed at achieving both aesthetic and functional advantages.



3. Condition Survey

A comprehensive condition survey was undertaken to evaluate both the structural integrity and aesthetic state of the ceramic dog. This assessment documents existing damage and identifies potential vulnerabilities and damage sources that may compromise the sculpture's stability. The findings form the basis for a conservation strategy aimed at mitigating deterioration, addressing structural concerns, and ensuring long-term preservation.

The preliminary examination revealed that, of the eight sculptures, only the black-and-white striped dog had sustained the most significant damage. It had broken into seven fragments due to impact-related breakage and was covered in accumulated dirt. In contrast, the remaining seven dogs, while structurally intact, exhibited major problems, including surface loss exposing the clay body, heavy dust accumulation, and widespread blackened biological growth affecting all surfaces (Fig. 20). No previous conservation treatments have been undertaken on this object or any part of the remaining installation.



Figure 20 : Extensive losses with blackened biological growth on one of the dog installation.

In contrast, the black-and-white striped dog allocated to me was in a severely compromised structural state, having fragmented into multiple pieces (seven). Notably, this was the only piece within the installation that had suffered such extensive breakage. The tail was broken into two pieces, and all four legs had detached from the body (Fig. 21, 22). However, the exact cause of this damage remains unknown, as no further information regarding the breakage is available.



Figure 22 : The body of the ceramic dog is in one piece.



Figure 21 : Four legs, two pieces of tail detached from the ceramic body.

The ceramic is composed of moulded clay, which has a layer of glaze and was fired at mid-range temperature suitable for stoneware ceramics. Due to prolonged exposure to the outdoor environmental conditions, the material had become fragile, with structural weakness exacerbated by both physical breakage and potential internal deterioration caused by salt crystallization and biological growth (Tite 2008). These factors likely contributed to the progressive weakening of the ceramics over time. The extent of the damage underscored the fragility of the object and emphasized the necessity of careful handling by trained professionals to ensure its proper conservation and preservation.

During the initial condition assessment conducted on 22 February 2024, visible cracks were observed across the underglaze layer of the ceramic surface. Initially, these cracks were assumed to be a potential factor contributing to deterioration. However, research revealed that they were an intentional feature of the manufacturing process rather than a defect (Fig. 23).



Figure 23 : Close-up of the intentional cracks as part of the Celadon technique.

The object was transferred to the conservation laboratory on 12 February 2023. During transportation, it was carefully packed in bubble wrap, with each fragment individually wrapped and placed in Euro storage boxes. Upon unpacking during condition assessment over a year later, significant dust accumulation and surface flaking were observed. Loose flakes were found scattered within the bubble wrap packaging of each piece, indicating further material glaze loss. These flakes and detached clay particles were systematically collected, labelled according to their corresponding pieces, and preserved for further examination and testing.

3.1. Ceramic body

The breakage of the ceramic object appears to have resulted from impact damage, likely due to improper handling, movement, or transportation. The precise cause remains uncertain. The impact led to a significant crack below the neck, extending downward along the body during the potential object's fall (Fig. 24), further compromising the sculpture's structural integrity.



Figure 24 : Close-up of a major crack due to impact damage.

Significant wear and tear are most evident on the underside of the legs, likely caused by movement and friction (Fig. 25 and 26). This area is unglazed, leaving the exposed clay more susceptible to surface deterioration. Given that each ceramic dog in the installation weighs 60 kilograms, the risk of abrasion on the underside is notably high.



Figure 25 : Close-up of the underside of leg 1.



Figure 26 : Close-up of the underside of leg 2.

The presence of moisture within the ceramic structure may have contributed to deterioration. As moisture migrates through the porous ceramic, the cycle of expanding and contracting begins, leading to internal stress, weakening the material structure over time (Price 2007; Arnold 2009).

Loss of the clay body due to previous impact damage led to the breakage of the object into multiple pieces. Areas that experienced direct impact suffered material loss, compromising the structural stability of the object (Fig. 27).



Figure 27 : Close-up of area where clay body has been lost due to impact damage.

3.2. Glaze

While superficial dirt and staining do not directly contribute to structural deterioration, they can significantly affect the object's visual appearance. Dust and particulate matter are hygroscopic, and capable of retaining moisture, which may accelerate surface deterioration over time (Appolonia 2004).

The ceramic installation has been displayed outdoors in a tropical, high-humidity climate, placed directly on the ground and near vegetation. These environmental conditions promote the growth of biological organisms, with mould spores and moisture from the air contributing to the spread of organic deposits on the surface. The pattern of biological growth suggests an upward spread from the ground into the object, forming a green tint in a floret dot pattern (Fig. 28). The formulation of biological growth on the surface, especially in the areas with crackle pattern, can alter the aesthetic appearance of the ceramic surface (Maravelaki-Kalaitzaki et al. 2003).



Figure 28 : Close-up of biological growth on lower body in a green floret dot pattern can also lead to lifting glaze.

Numerous areas of the object exhibit loss of the glaze layer. In some sections, the glaze has completely detached, exposing the underlying clay. In some sections, the glaze appears slightly lifted but remains partially adhered (Fig. 29). Flaking can result from various environmental factors. However, attempting to flatten and reattach these lifted sections can be challenging, as the stiffened glaze is prone to breakage. Rapid fluctuations in temperature can cause the ceramic body to expand and contract, leading to eventual detachment of the glaze layer, exposing the underlying clay (Rado 1988).



Figure 29 : Close-up of area exhibiting lifting, loss of glaze layer.

Crazing (fine cracks in the glaze) can occur over time, and the intentional crackle glaze characteristic of celadon ceramics can develop into unintended deterioration due to prolonged environmental exposure. During the manufacturing process, celadon glaze is designed to form a network of fine cracks as it cools, a result of differential contraction between the glaze and the ceramic body. While initially stable, these cracks can expand and deepen when subjected to external forces such as fluctuating temperatures, high humidity, and pollution. The penetration of moisture in the cracks can weaken the glaze,



Figure 30 : Close up of areas of underglaze fine cracks slightly lifting from clay layer.

and deepen when subjected to external forces such as fluctuating temperatures, high humidity, and pollution. The penetration of moisture in the cracks can weaken the glaze,

leading to progressive detachment and structural instability. The formation of fine cracks within the glaze can gradually lead to detachment, particularly in humid environments (Fig. 30) (Brill 2018). While certain celadon ceramics intentionally fracture crackled glazes as part of their design, excessive deepening of these cracks may result in further material loss.

4. Aim and Concept of Conservation

The primary objective of the conservation treatment is to restore the structural integrity of Thanatnoond Kumprommarat's ceramic sculpture, *Textured Dog*.

Conservation concerns include structural breakages, surface cracks, flaking, and loss of the glaze layer, all of which compromise the material's physical stability and aesthetic value (Cronyn 2006). Addressing these issues requires a combination of interventive treatments and preventive measures, which include a controlled environmental setting indoors, proper handling and transport procedures, and routine maintenance practices (Appelbaum 2007; Caple 2000). These strategies form part of a broader risk management approach to ensure the long-term preservation of the object (Staniforth 2013).

A custom-designed storage and transportation box will be fabricated to provide the necessary protection during transit to the Sanamchandra Art Gallery. Designed for durability and long-term storage, the box is intended to facilitate safe transportation. The *Textured Dog* object will be brought to the gallery and stored indoors with the remaining installation until the exhibition space on the third floor is completed, after which the installation will be permanently displayed indoors as part of the gallery's expansive ceramic collection.

4.1. Dry cleaning

Dry cleaning is an essential step in the conservation of ceramic objects. This process involves carefully removing loose dust and debris from the surface without using liquids or solvents. Dust can absorb moisture and interact with environmental pollutants, creating acidic conditions that contribute to the deterioration of ceramic surfaces through glaze corrosion and staining, particularly in areas of existing damage, such as cracks and losses in the glaze layer (Cronyn 2006; Conserve O Gram 1993). Dust often contains abrasive materials like silica and grit, which can cause micro-scratches during handling or movement (Caple 2000). Removing surface dirt sooner rather than later is usually desirable to avoid the danger of it becoming drawn into the body or the cracks. The removal of dirt is an irreversible process and requires careful consideration and testing before the intervention begins (Buys and Oakley 1993).

Prior to selecting a suitable material for dry cleaning *Textured Dog*, five commonly used conservation materials were tested to evaluate their cleaning effectiveness and compatibility with the object's ceramic surface. The aim was to identify the most efficient option that would minimise potential risks to the fragile structure.

The materials tested included soft-bristle brushes, polyurethane (PU) sponges¹⁷, vulcanised latex sponges (Akapad)¹⁸, smoke sponges¹⁹, and cosmetic wedges²⁰ (See Table 1). These were selected based on their established use in conservation practices and their availability within Thailand. Each dry-cleaning material was tested on inconspicuous areas of *Textured Dog*. Test areas included the underside, leg edges, and back corners of the sculpture, representing a range of typical surface conditions. The surfaces assessed varied from unglazed clay to glazed surfaces, ensuring comprehensive evaluation across different material responses.

For each material, several key parameters were evaluated. Cleaning effectiveness was assessed by observing the visual reduction of surface dirt. Surface impact was examined under raking light to detect any signs of abrasion, glaze lifting, or scratching. Residue or disintegration was evaluated through the collection of any particles left behind. Additionally, each material's handling and controllability were considered particularly in relation to its adaptability to curved surfaces.

All tests were conducted under stable environmental conditions within the conservation laboratory. Photographic documentation was carried out before and after each test to provide a visual record of the results. Observations were systematically recorded using a standardised evaluation sheet, which considered five criteria: cleaning efficacy, surface safety, residue generation, ease of use, and reversibility. The results of the tests directly informed the final selection of the dry-cleaning method, favouring a technique that was both effective and minimally invasive to the ceramic surfaces.

Table 1 : Testing dry cleaning materials for *Textured Dog*.

Material	Surface type tested	Test area location	Criteria evaluated	Assessment method + Notes and observations
Soft-bristle brushes	Area of loss, clay below	Underside/back of object	Dust removal efficiency, surface abrasion	Visual inspection under raking light. Monitored for micro-scratches and glaze lifting.

¹⁷ Polyurethane (PU) sponges, manufactured by Deffner & Johann GmbH, Germany.

¹⁸ Akapad sponges, manufactured by Kremer Pigmente GmbH & Co, KG, Germany.

¹⁹ Smoke sponges, manufactured by Preservation Equipment Ltd, England.

²⁰ Common makeup sponges, manufacturer varies by distributor.

Material	Surface type tested	Test area location	Criteria evaluated	Assessment method + Notes and observations
Polyurethane (PU) sponges	Glazed ceramic, slip surface around loss	Lower leg/back corner	Lifting dirt, sponge residue	Visual Examination under raking light. Checked and removed dirt on the sponge and checked for any glaze lifting due to pressure.
Vulcanised latex sponges (akapad)	Glazed ceramic	Interior flank	Crumbling pattern, cleanliness, effect on lifting glaze	Visual examination under raking light. The sponge was crumbling, leaving behind particles. Checking under magnification for particles embedded within flaking glaze areas.
Smoke sponges (Chemical sponge)	Glazed ceramic	Near base tail	Smudge removal, residue left, sheen alteration	Visual examination under raking light. Compared before/after sheen, assessed surface tackiness, and any residual traces.
Cosmetic wedges	Glazed ceramic	Base of the back	Dirt pick-up, colour change, and stability of the sponge	Visual examination under raking light. The sponge removed dirt; its continuous use was avoided due to insufficient information regarding its material composition, manufacturing process, and long-term compatibility with the ceramic.

The comparative assessment revealed strengths and limitations across the different materials. Soft-bristled brushes, although effective for removing loose dust, posed a risk of dislodging unstable glaze during vacuum-assisted cleaning. Akapad sponges demonstrated strong cleaning performance but produced fine crumbling particles that could become embedded within cracks, compromising long-term stability. Smoke sponges lifted surface grime successfully, yet their rubbery residues had the potential to alter the sheen of glazed surfaces, necessitating further intervention. Cosmetic wedges were found to be the least suitable option due to their low durability, tendency to disintegrate, and limited cleaning efficiency rendered them inappropriate for ceramic conservation.

Following this evaluation, polyurethane (PU) sponges emerged as the most effective and appropriate material for the dry cleaning of *Textured Dog*. Their smooth, flexible, and lint-free properties, combined with the ability to attract dust through a mild static charge, enabled efficient cleaning without applying unnecessary pressure. This quality was especially important given the object's fragile condition, with areas of glaze loss and instability. PU sponges therefore provided a controlled, material-sensitive approach that minimised the risk of mechanical damage while ensuring optimal cleaning results (Fig. 31).



Figure 31 : Soft bristled brush and PU sponge.

These findings highlight the importance of selecting appropriate cleaning materials and techniques to ensure that conservation interventions do not compromise the condition of the object. A carefully controlled dry cleaning process not only enhances the object's optical clarity and presentation but also facilitates ongoing condition monitoring while reducing the risk of cumulative damage. In doing so, the conservation treatment supports the long-term preservation of the material, its authenticity, and its interpretive values for future generations (Van den Burg and Seymour 2022).

4.2. Wet cleaning

Wet cleaning constitutes an essential phase in the conservation process, particularly when dry cleaning proves insufficient to remove embedded dirt, surface residues, or microbiological growth. While dry cleaning effectively lifts loose particulate matter, it does not address contaminants that have bonded to the surface over time or migrated into microcracks, especially in porous ceramics. These embedded residues can promote long-term degradation by retaining moisture or organic matter that encourages salt migration, microbiological growth, and glaze deterioration (Buys and Oakley 1993; Koob 1986).

Controlled wet cleaning, using carefully selected solvents such as deionised water, ethanol, or acetone, allows for the targeted removal of these deeper contaminants while minimising the risk of physical or chemical alteration to the object. However, because wet cleaning introduces moisture, even in minimal amounts, the technique must be used selectively and with caution. Testing is essential to ensure compatibility with the ceramic material, as improper solvent choice or application can lead to tide marks, salt mobilisation, or surface disruption (Caple 2000; Buys and Oakley 1993). When executed properly, wet cleaning significantly improves the aesthetic clarity of the object, aids in condition monitoring, and contributes to the long-term preservation of the ceramic by stabilising its surface condition.

Prior to selecting a suitable material for wet cleaning *Textured Dog*, three commonly used conservation materials were tested to evaluate their cleaning effectiveness and compatibility with the object's ceramic surface (See Table 2). The aim was to safely remove embedded dirt, stains, and any biological residues, while ensuring that the process does not compromise the structural integrity and surface finish of the object. Ethanol-water²¹ mixtures are known for their ability to lift embedded dirt while offering microbial benefits through protein denaturation and lipid membrane disruption. Acetone²² was included for its rapid evaporation and effectiveness in removing oily or greasy residues. Deionised water served as a baseline control, but was used cautiously due to its potential to mobilise soluble salts and leave tide marks on porous ceramic surfaces (Buys and Oakley 1993).

Each wet cleaning agent was tested on discrete areas of *Textured Dog*, including the lower flank, base edges, and interior recesses. These areas represented a range of typical surface conditions found on the sculpture.

For each cleaning agent, several parameters were evaluated for each cleaning solution. The cleaning effectiveness was determined by the visible removal of dirt, staining, and biological residue. Surface response was examined under raking light to detect any changes in sheen, surface dulling, or glaze disruption. Residue or streak formation was monitored after drying to assess the potential of solvent-related deposits. Volatility and drying behaviour were observed to determine each solvent's suitability for use on the object. Finally, compatibility with the ceramic substrate was evaluated, particularly in areas with lifting glaze.

Like the dry-cleaning tests, all these tests were carried out under stable laboratory conditions. The treated areas were documented photographically before and after application, and all observations were recorded using a standardised evaluation sheet. Criteria included cleaning efficacy, surface safety, residue generation, ease of application, and overall material compatibility. The results of these tests informed the selection of a wet cleaning method that was both effective and minimally invasive, supporting the long-term preservation and visual clarity of *Textured Dog*.

²¹ Ethanol (95% Laboratory Grade), manufactured by Merck KGaA, Germany or equivalent.

²² Acetone (95% Laboratory Grade), manufactured by Merck KGaA, Germany or equivalent.

Table 2 : Testing wet cleaning materials for *Textured Dog*.

Cleaning solution	Surface type tested	Test area location	Criteria evaluated	Assessment and observations
Deionised water	Glazed ceramic	Underside/ near front left leg	Dirt solubility, surface reaction, water retention	Minimal cleaning effect on greasy or embedded dirt, safe to use on the surface.
Ethanol: Deionised water (50:50)	Glazed ceramic	Underside/ near the back right leg	Cleaning efficiency, antimicrobial effect, surface impact, drying time	Effective removal of embedded grime, no visible alterations to glaze layer; fast drying, reduced surface tension
Acetone: deionised water (50:50)	Glazed ceramic	Interior/ back tail	Grease solubility, evaporation rate, surface disruption, or residues	Efficient removal of oily residues, no watermarks, rapid evaporation, helped limit moisture exposure, and no reaction with stable glaze layer

The comparative assessment revealed distinct advantages and limitations for each cleaning solution. Deionised water alone exhibited limited cleaning power and frequently left water stains, particularly on porous surfaces, making it unsuitable for areas of exposed ceramic body. Acetone effectively dissolved oily residues but evaporated too rapidly, offering insufficient working time to control the cleaning process. This volatility also made it difficult to prevent uneven cleaning. By contrast, the ethanol-water mixture combined moderate volatility with effective dirt removal. It successfully lifted embedded grime, neutralised microbiological residues through its antimicrobial properties, and dried quickly enough to minimise moisture retention, while still providing sufficient working time for controlled cleaning.

Following these tests, the ethanol-water mixture (50:50) emerged as the most effective and appropriate solution for wet cleaning *Textured Dog*. Its balanced cleaning efficacy, safety, and controlled evaporation allowed for a material-sensitive approach that minimised the risk while achieving optimal results. Application was carried out using lightly dampened swabs followed by immediate blotting to avoid water ingress, particularly in the areas of loss where the clay body was exposed. This controlled method not only improved the aesthetic clarity of the object but also contributed to its

long-term stability by neutralising biological residues and stabilising the surface condition.

4.3. Consolidation

Consolidation represents an essential step after wet cleaning in the conservation of ceramics, particularly when flaking or lifting glaze layers threaten the structural and visual stability of the surface (Tennent 1992; Kingery and Vandiver 1986). During the condition assessment of the ceramic sculpture, areas of partially detached glaze and localised losses were observed, most prominently concentrated on the lower half of the object. This deterioration is likely attributed to prolonged outdoor exposure, where environmental factors such as moisture infiltration and biological activity exacerbate material instability. A targeted consolidation treatment was decided upon before dry and wet cleaning to stabilise vulnerable areas and prevent further loss during subsequent conservation procedures (Tite 2008).

Consolidation involves carefully introducing a diluted consolidant into the areas of lifting glaze and loss within the ceramic body. The consolidant is delivered using precision tools such as fine brushes or micro-syringes, ensuring localised application to lifting edges or areas of glaze cracking. Once the consolidant has set, excess residue on the surface is removed with a suitable solvent to maintain the object's aesthetic integrity. As this procedure is often irreversible, its application must be limited to cases where structural risk is evident (Conserve O Gram 2002).

To address areas of flaking, weakened lifting glaze on *Textured Dog*, two Paraloid B-72-based consolidant solutions were tested for their effectiveness and compatibility with the object's surface. Paraloid B-72²³ is a widely accepted thermoplastic acrylic resin in conservation, valued for its transparency, reversibility, long-term stability, and non-yellowing properties (Koob 1986; Down 2015). Both solutions were prepared at a 5% w/v concentration: one using ethanol and the other using acetone as a solvent base. These were selected due to their solvent polarity, penetration of the consolidant, evaporation rate, and prevalence in ceramic conservation practices. Each consolidant solution was tested on discrete areas of *Textured Dog*, including inner fracture edges and the back of the lower legs (Fig. 32). These locations were



Figure 32 : Testing on inner edge of broken leg.

²³ Paraloid B-72, manufactured by Kremer Pigmente GmbH & Co, KG, Germany.

selected to represent the range of structural vulnerabilities observed across the sculpture.

Several parameters were evaluated for both consolidants (See Table 3). Penetration depth was assessed visually and through tactile inspection, focusing on how well the solution reached into porous areas. Surface response was examined under raking light to detect any gloss alteration, residue formation, or visible film. Drying behaviour and working time were monitored to assess suitability for various levels of surface sensitivity. Additionally, handling characteristics such as brush controllability and flow were considered. The overall compatibility with the ceramic substrate was evaluated, particularly in zones with exposed clay.

As part of both dry and wet cleaning phases, all consolidation tests were conducted under controlled laboratory conditions. The treated areas were documented photographically before and after application, and all findings were recorded using a standardised evaluation form. Criteria included consolidant efficacy, surface penetration, visual impact, and ease of application. These results informed the selection of a material-sensitive consolidation approach that would reinforce structurally compromised areas of loss of *Textured dog*, while preserving its visual and material authenticity.

Table 3 : Testing consolidants for *Textured Dog*.

Consolidation solution	Solvent base	Test area location	Criteria evaluated	Assessment and observations
5% Paraloid B-72 in ethanol (25 ml)	Ethanol	Inner fracture edge	Penetration depth, film formation, visual change, drying time, surface cohesion, substrate reaction, handling control	Good penetration into porous areas of losses, a stable transparent film; slight sheen observed; slower evaporation allowed greater working time.
5% Paraloid B-72 in acetone (25 ml)	Acetone	Inner fracture edge		Rapid drying. Strong initial adhesion to edges, no visible residues, film dried evenly.

Paraloid B-72 in ethanol exhibits several key advantages. The ethanol carrier provides moderate volatility, which allows adequate working time and greater control during application. This property proved beneficial in areas requiring precise manipulation,

such as lifting glaze edges and areas of loss. The solution demonstrated effective penetration into porous areas without pooling or over-saturating the surface. Upon drying, it formed a transparent, stable film that reinforced weak areas while maintaining the semi-gloss character of the original finish.

In contrast, the acetone-based solution, while effective in rapid drying and initial adhesion, presented certain limitations. Its high volatility reduced the working time significantly, increasing the risk of uneven application or consolidation failure, particularly in highly absorbent areas. The rapid evaporation rate could cause whitening effects if applied liberally. This made the acetone solution less adaptable for use on the sculpture.

Ceramics requiring consolidation often exhibit damage resulting from fluctuations in environmental humidity, which promote harmful cycles of drying and wetting. These conditions contribute to the progressive weakening of glaze and slip layers as observed in *Textured Dog*, necessitating timely and targeted intervention (Buys and Oakley 1993). Based on the results of consolidant testing, Paraloid B-72 in ethanol, 5% w/v, was selected for its controlled application for use on *Textured Dog*. The use of this consolidant supports the broader conservation goal of long-term preservation, while maintaining both the aesthetic and physical integrity of the object.

4.4. Joining

The reassembly of broken ceramic components is crucial when the aim is to restore the object's structural integrity and visual coherence. Bonding broken fragments not only reinstates the original or near-original form but also mitigates the risk of further mechanical deterioration, staining along break edges, and loss of smaller elements during handling or display (Buys and Oakley 1993). In addition to aesthetic and structural objectives, effective gluing ensures the object's suitability for exhibition and facilitates long-term preservation.

The joining of ceramics requires adhesives that are mechanically strong, chemically compatible, and minimally intrusive. In the case of *Textured Dog*, which has broken into seven pieces, the selection of an appropriate adhesive was critical to achieving a secure repair. Several factors were considered during adhesive selection, including the ceramic's physical properties, the nature and location of the breakage, weight of the object, reinstallation placement, and the long-term retreatability conservation objectives. Ideally, the chosen adhesive should offer strong bonding capabilities, good ageing stability, and potential for future reversibility (Cronyn 2006). To support this, the application must be precise to avoid excess residue and visual disruption, ensuring the object's authenticity is maintained (Tennent 1992).

A series of two-part epoxy adhesives available in the conservation lab was tested (See Table 4): Pattex Power Epoxy Clear Quickset²⁴, Xtraseal 4-minute epoxy²⁵, UHU Plus Endfest 300²⁶, and Alteco 2-Part Epoxy²⁷. These were selected based on their strength, curing properties, and availability in Thailand. A mock ceramic pot was intentionally broken to allow each of the four epoxy adhesives could be applied and tested. This process enabled the evaluation of each adhesive's performance under realistic joining conditions.

The evaluation of each adhesive was based on several key parameters. Bond strength was assessed by examining the adhesive's ability to securely hold ceramic fragments under pressure. Curing time and working flexibility were considered in terms of how much time was available for precise alignment before the adhesive began to set. Application behaviour focused on the ease of mixing, consistency, and flow characteristics during use. Visual properties were evaluated by observing the adhesive's appearance after curing, particularly its colour, clarity, and sheen. Reversibility and retreatability were assessed by determining the ease with which the adhesive could be removed if needed, as well as its impact on the ceramic surface.

Joining was performed by aligning the fragments and introducing the adhesive at the break interface. When breaks involved minor cracks or losses, gap-filling capacity was essential. Prior to adhesion, surfaces were cleaned with solvent-dampened sponges to remove any dust and contaminants from the joining surface (Buys and Oakley 1993). In all areas of joining, an isolating barrier layer was applied to support future retreatability.

All the tests were conducted under controlled laboratory conditions, with photographic documentation taken before and after application. Observations were logged using a standardised evaluation form. The results informed the final selection of an adhesive that were effective, visually discreet, and aligned with conservation ethics. This careful approach supported the long-term preservation and presentation of *Textured Dog*, adhering to the principles of minimal intervention and material sensitivity.

²⁴ Pattex Power Epoxy Clear Quickset, manufactured by Henkel AG & Co. KGaA, Germany.

²⁵ Xtraseal 4-minute epoxy, manufactured by Syarikat Pemung Hwa Industrial Sdn Bhd, Malaysia.

²⁶ UHU Plus Endfest 300, manufactured by UHU GmbH & Co. KG, Germany.

²⁷ Alteco Epoxy 2-part, manufactured by Alteco Chemical Pte Ltd, Singapore (subsidiary of Alteco Co., Ltd., Japan).

Table 4 : Testing Adhesives for *Textured Dog*.

Adhesive	Type	Working time	Criteria evaluated	Observations
Pattex Power Epoxy clear quickset	2-part clear epoxy	5 minutes	Bond strength, clarity, alignment control, residue removal, curing speed, and viscosity	Strong bond and fast setting, clear appearance when cured, short working time
Xtraseal 4-minute epoxy	2-part clear epoxy	3 – 4 minutes		Sets rapidly with high strength, minimal yellowing, suitable for small breaks, and short working time
UHU Plus Endfest 300	2-part epoxy	90 – 120 minutes (slow set)		Long working time is ideal for precision, strong mechanical properties, and easy to remove residues
Alteco Epoxy 2-part (clear)	2-part epoxy	5 – 6 minutes		Good adhesion and transparent finish, sets rapidly, no time for precision, slow working time

The comparative assessment revealed distinct advantages and limitations for each adhesive tested. Pattex Power Epoxy Clear Quickset cured very rapidly, which provided immediate strength but left insufficient working time for accurate alignment of irregular fragments. This resulted in visible joints and excess adhesive residue. Xtraseal 4-Minute Epoxy demonstrated similar drawbacks, with its fast-setting time limiting precision and increasing the risk of misaligned joints, making it unsuitable for larger structural fragments.

Alteco 2-Part Epoxy offered slightly more control during application, but its low viscosity caused spreading along the fracture edges, leaving a glossy residue that was visually intrusive. By contrast, UHU Plus Endfest 300 combined long working time with strong adhesion. Its curing time of 90–120 minutes allowed careful positioning of fragments, while its high bond strength ensured structural stability suitable for load-bearing sections such as the legs. The cured adhesive remained discreet, without significant discolouration or surface gloss.



Figure 33 : Area of joint using UHU (see red).

Following adhesive testing on a mock ceramic pot (Fig. 33), UHU Plus Endfest 300 was determined to be the most suitable adhesive for the structural joining of *Textured Dog*. Its extended working time of approximately 90 to 120 minutes provided the necessary flexibility for accurate alignment of complex joints, allowing precise repositioning of fragments without the time pressure of rapid curing. This was particularly beneficial given the irregular and fragile break edges of the sculpture. Once cured, the adhesive demonstrated high mechanical strength and excellent adhesion, ensuring long-term structural stability. In terms of visual performance, UHU Plus Endfest 300 cured without discolouration, and its relatively high viscosity allowed controlled application with minimal run-off and overspill. Application was carried out under controlled conditions, the object was placed on dense Ethafoam giving it the stability to hold the heavy body of the object in place, the fragments were aligned using clamps and in a step-by-step process, each piece was glued onto the body and excess adhesive carefully removed before curing. This ensured strong, precise joints that reinstated both the physical stability and visual coherence of the sculpture.

4.5. Filling

The primary objective of a structural fill is to restore an object's physical integrity and mechanical stability by addressing areas of material loss. These fills are critical in reinforcing weakened section and bridging gaps between fragmented elements to prevent further damage or collapse. Often employed in conjunction with adhesives, structural fills are particularly valuable in cases where direct joins are incomplete or absent, helping to distribute mechanical stress and ensure structural continuity (Buys and Oakley 1993).

Filling is a crucial step in the conservation of ceramic objects, serving both structural and preventive functions. In *Textured Dog*, the fractures caused by earlier damage resulted in gaps and material losses along the break interfaces, particularly around the legs and tail joints. To restore structural integrity and prevent the accumulation of dirt or biological growth in these areas, carefully controlled filling was required. Left untreated, such losses can compromise the long-term stability of the object, allowing contaminants to penetrate and deteriorate the ceramic substrate over time (Tite 2008).

Although visual reintegration is often considered a secondary aim, particularly in display contexts, the mechanical strength, chemical stability, and compatibility of the fill material remain the primary criteria for its implementation (Caple 2000). In accordance with conservation ethics, all materials used for filling must be distinguishable from the original, reversible where possible, and safe for long-term use on heritage objects. To assist this thought, a barrier layer was applied prior to the application of the filling.

Due to the limited availability of conservation-grade filling materials in Thailand, a pragmatic approach was adopted. Epo Putty (Alteco)²⁸, a commercially available two-part epoxy-based putty was selected for testing. Its widespread regional use, strong adhesion, and gap-filling capacity made it a viable candidate for conservation under the circumstances. To improve its workability and visual compatibility with the ceramic body, the putty was modified by adding marble dust and clay-toned dry pigments (Fig. 34). This yielded a customised fill material with improved bulk, a smoother texture, and a colour tone that blended sympathetically with the base ceramic, without attempting to mimic decorative elements.



Figure 34 : Close-up of dry pigments used for testing.

Table 5: Testing Filling Material for *Textured Dog*.

Material	Application sites	Parameters evaluated	Assessment and observations
Epo Putty - plain (Alteco)	Areas of gap on the mock ceramic pot.	Adhesion to ceramic surfaces, workability, and modifiability (ease of mixing with additives, application control), curing time and stability, finish, and visual integration	Excellent adhesion and cohesion, bonds well with the ceramic, workability enhanced by adding marble dust and clay-toned dry pigments, good working time, curing time overnight, off white base improved to match clay body tone, not retouched

Table 6 : Epo Fill Testing 1.

EPO FILL TESTING 1 WITH DRY PIGMENTS (Conducted on 17 April 2025).		
Sr.No.	Dry pigments	Observations
1.	Titanium white, yellow, tint of brown ochre	The initial set of tests was conducted without precise measurements and was instead based on preliminary observational trials evaluated visually.
2.	More titanium white, less yellow, brown ochre	
3.	Titanium white, less yellow, tint of orange	
4.	Titanium white, yellow, tint of brown ochre, tint of dark pink	

²⁸ Epo putty (two-part epoxy putty) (Alteco), manufactured by Alteco Chemical Pte Ltd, Singapore. (Subsidiary of Alteco Inc, Fukuoka, Japan).

Table 7 : Epo Fill Testing 2.

EPO FILL TESTING 2 WITH DRY PIGMENTS (Conducted on 22 April 2025).	
Sr. No.	Ratios
1.	Base (2-part epo putty mixed) without weighing + 0.50g Titanium white + 0.50g Yellow ochre
2.	Base (2-part epo putty mixed) without weighing + 0.50g Yellow ochre + 1g Titanium white
3.	Base (2-part epo putty mixed) without weighing + 0.20g Yellow ochre + 0.80g Titanium white
4.	Base (2-part epo putty mixed) without weighing + 0.50g Yellow ochre + 0.90g Titatinum White

Table 8 : Epo Fill Testing 3.

EPO FILL TESTING 3 WITH DRY PIGMENTS (Conducted on 22 and 23 April 2025).		
Sr. No.	Ratios	Observations
1.1.	Base (2-part epo putty mixed) + 0.10g Yellow + 0.90g Titanium white + 0.01g Brown ochre + 0.01g Dark pink	The base (2-part epo putty mixed), each part was equally measured at 2g each on a weighing scale and combined for all tests
1.2.	Base (2-part epo putty mixed) + 0.10g Yellow + 1.20g Titanium white + 0.01g Brown ochre + 0.01g dark pink	
2.	Base (2-part epo putty mixed) + 0.10g Yellow + 1.60g Titanium white + 0.01g Brown ochre + 0.02g Dark pink	
3.	Base (2-part epo putty mixed) + 0.10g Yellow + 2g Titanium white + 0.04g Brown ochre + 0.02g Pink	
4.	Base (2-part epo putty mixed) + 0.10g Yellow + 3g White + 0.04g Brown ochre + 0.03g Dark pink	

The comparative assessment of filling materials highlighted distinct advantages and limitations. Epo Putty in its unmodified form demonstrated strong adhesion and excellent gap-filling capacity, but its coarse texture and bright curing colour created visual discord with the ceramic body. Furthermore, its unaltered surface remained difficult to blend and susceptible to noticeable contrast under natural light conditions. The addition of marble dust improved bulk and workability, producing a smoother fill that was easier to shape and finish. However, on its own, the colour remained starkly different from the surrounding ceramic. By contrast, the formulation combining Epo Putty, marble dust, and clay-toned dry pigments produced the most satisfactory results.



Figure 35 : Close-up of Epo filling on mock ceramic pot.

This mixture retained the adhesive strength and structural reliability of the epoxy base, while achieving a sympathetic colour tone and finer texture that integrated more discreetly with the object. Testing on a mock ceramic pot (Fig. 35) confirmed its stability, controlled curing, and low response to environmental fluctuations, making it well-suited for outdoor display (see Tables 5–8).

Following these tests, the customised mixture of Epo Putty, marble dust, and dry pigments emerged as the most effective and appropriate fill for *Textured Dog*. Its combination of structural reinforcement, stability, and visual neutrality allowed for a material-sensitive response to losses along the leg and tail joints. Application was carried out after the placement of a barrier layer, ensuring reversibility and separation from the original ceramic. The fills were coloured to match the base clay tone rather than replicate decorative elements, in line with conservation ethics and the ensemble's outdoor context. This approach reinstated physical stability while avoiding misrepresentation of the sculpture's original surface, achieving a balance between structural necessity and ethical presentation.

4.6. Protective coating

The application of a protective coating is a crucial final step in ceramic conservation, particularly when dealing with outdoor sculptures like *Textured Dog*, which are exposed to fluctuating humidity, airborne pollutants, and mechanical abrasion. This intervention serves not only to protect the original ceramic surfaces but also to safeguard structurally important fills, ensuring both components remain stable and coherent over time.

Fills, while essential for stabilising areas of material loss, are typically composed of substances that differ from the original ceramic in terms of porosity, surface texture, and composition. Without a suitable barrier, these fills are vulnerable to soiling, moisture absorption, discolouration, and surface abrasion, especially in outdoor or semi-exposed environments. A protective coating addresses these vulnerabilities by sealing the fill material, reducing its porosity, and offering a uniform surface sheen that supports visual consistency across the restored object (Buys and Oakley 1993; Tennent 1992).

In the case of *Textured Dog*, the limited availability of conservation-grade materials in Thailand necessitated a pragmatic approach. Paraloid B-72, an acrylate copolymer, was the only suitable coating material accessible. Its proven stability, chemical inertness, and excellent ageing stability and reversibility make it a widely used and respected material in conservation. Although commonly employed for objects kept outdoors due to its resistance to yellowing and good weathering properties, its benefits extend equally to indoor contexts. When applied indoors, Paraloid B-72 offers long term stability without embrittlement, forms a clear and flexible film that preserves the legibility of the surface detail underneath, and provides a protective barrier against dust accumulation and handling-related abrasion. Its reversibility also ensures that future interventions can be undertaken without compromising the ceramic substrate (Cronyn 2006; Caple 2000). The protective coating was tested in three concentrations: 10%, 12%, and 15% (w/v) of Paraloid B-72²⁹ in acetone to evaluate differences in film thickness, sheen, drying time, and application behaviour (Fig. 36) (See Table 9). Each solution was applied to a dried, square sample of plain Epo putty (Alteco) (Fig. 37). Epo putty, as the chosen fill material, while structurally effective, tends to yellow over time. The protective coating thus also served to slow this visual degradation while partially matching the gloss level of the surrounding glaze.



Figure 36 : Paraloid B-72 varying ratios for testing purposes.



Figure 37 : Epo putty square for protective coating testing.

Table 9 : Testing protective coating materials for *Textured Dog*.

Concentration	Application areas	Parameters evaluated	Assessment and Observations
10% Paraloid B-72 in acetone	Each solution was applied to a dried, square sample of EPO putty (Alteco),	Film consistency, drying time, surface sheen, reversibility, Evenness of	Formed a thin film with minimal sheen, coverage slightly patchy overall, glossy appearance

²⁹ Paraloid B-72, manufactured by Kremer Pigmente GmbH & Co, KG, Germany.

Concentration	Application areas	Parameters evaluated	Assessment and Observations
12% Paraloid B-72 in acetone	plain without dry pigments.	application, adhesion to surface, solvent control, gloss and film thickness, risk of pooling or streaking, visual alteration	Formed a smooth, thin film, glossy appearance. Even with multiple applications, the glossy appearance remained the same, matching the aesthetic gloss of the dog.
15% Paraloid B-72 in acetone			Created a glossier, thicker coating that was very glossy in appearance, less suitable due to sheen and slow drying time

Following testing, the 12% solution was identified as the most appropriate concentration for final use. It formed a smooth, even film with a satin-finish that enhanced surface readability and gave a glossy appearance closely matching the gloss of *Textured Dog*. The application was controlled and repeatable, with no significant pooling or streaking observed. Most importantly, the coating remained fully reversible, allowing for future retreatment if necessary.

In *Textured Dog*, Paraloid B-72 was applied as a protective coating to unify the surface gloss between original glaze and filled areas, slow the yellowing of the Epo Putty fills, and stabilise the object against minor environmental fluctuations. This treatment extended the longevity of both fills and ceramic surfaces while enhancing visual cohesion. By providing preventive protection and optical unity, Paraloid B-72 offered a material-sensitive solution consistent with conservation goals of long-term preservation, minimal intervention, and visual clarity, ensuring that *Textured Dog* remains structurally and aesthetically coherent for future interpretation and exhibition.

5. Measures Carried Out

5.1. Dry cleaning

The dry-cleaning process was undertaken using high-density, latex-free polyurethane (PU) sponges in conjunction with soft-bristled brushes to facilitate the controlled removal of surface dirt from all areas of the sculpture (Fig. 38). The soft and pliable nature of the PU sponges permitted gentle application across the surface,



Figure 38 : Close-up of dry cleaning using soft-bristled brush.

allowing for localised cleaning with minimal pressure. This approach was particularly beneficial in areas where the glaze exhibited lifting or instability, thereby reducing the risk of further damage (Buys and Oakley 1993). To prevent contamination from oils or residues, nitrile gloves were worn throughout the process. The cleaning process effectively eliminated surface dust and fine particulate matter. Although the visual appearance was subtle, a noticeable increase in surface gloss was observed following treatment, contributing to an enhanced overall appearance of the object.

The use of a vacuum cleaner was deliberately avoided due to the presence of a fragile and flaking glaze layer. Such equipment posed a significant risk, as suction could inadvertently cause further dislodging or irreversible loss of these glaze fragments. In contrast, the selected PU sponges offered a more suitable and non-invasive alternative, capable of dislodging dust without compromising the integrity of the glaze layer.

5.2. Wet cleaning

The wet cleaning was executed using a 50:50 ethanol-to-water ratio applied with a sponge. Excess liquid was blotted on absorbent paper to minimize moisture content, and the cleaning was carried out in a controlled, section-by-section manner. This approach effectively limited water exposure, particularly in areas where the clay body was exposed due to the glaze loss, thereby reducing the risk of further deterioration. The lower half of the sculpture, from the torso down to the base, exhibited the heaviest soiling, staining (Fig. 39 and 40), consistent with patterns of prolonged outdoor exposure and microbial colonisation. These contaminants had likely infiltrated beneath the glaze layer, following a path resembling the spread of tree root systems from ground contact upward. During cleaning, green discolouration on sponges confirmed the successful removal of biological residues.

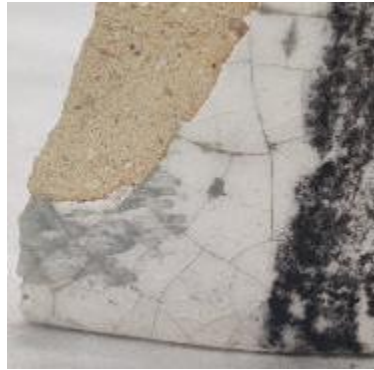


Figure 39 : Close-up of staining, before wet cleaning.

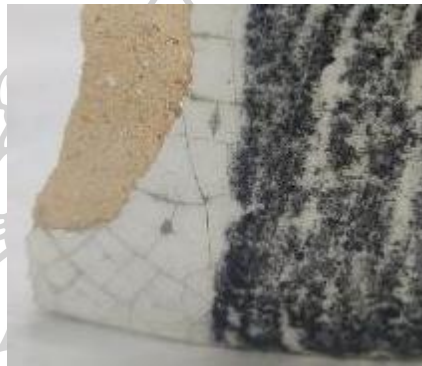


Figure 40 : Close-up of cleaned stain, after wet cleaning.

Following treatment, the ceramic surface exhibited enhanced gloss and clarity, indicating a significant improvement in its physical condition and visual appearance. The ethanol-water solution not only removed persistent dirt but also contributed to the stabilisation of microbiological growth in vulnerable areas, supporting the overall conservation objectives of the treatment.

5.3. Consolidation

A localised consolidation intervention was carried out to address areas of instability where the glaze exhibited partial detachment or lifting, and areas of loss in the ceramic body where the glaze was missing. These conditions posed a risk to both the physical preservation of the object and its visual coherence; the treatment aimed to arrest ongoing deterioration without altering the surface.

Paraloid B-72 was selected as the consolidant due to its recognised performance in conservation practice. Its properties, including optical clarity, chemical stability, and reversibility, make it suitable for ceramic applications (Koob 1986; Horie 2010; Appelbaum 2007). The application was confined to zones of active flaking and prior material loss (Fig. 41). A fine brush was used to deliver the solution, diluted in acetone, to the underside of the lifting glaze. This allowed the consolidant to seep beneath the flakes via capillary action, promoting secure adhesion between the glaze and the substrate. Special attention was given to avoid unnecessary spread, ensuring the treatment remained visually unobtrusive.



Figure 41 : Close-up of consolidation application.

To enhance bonding strength and ensure penetration into the porous matrix, a second application was applied once the initial layer had partially dried. The two-step process improved cohesion without introducing gloss or residue on the surface. The result was a stable, unified surface that maintained the original appearance of the object while safeguarding vulnerable features.

5.4. Joining

To restore the structural integrity of *Textured Dog*, the detached components of the legs and tail were reattached using a controlled process. Prior to joining, an isolation layer of 7% Paraloid B-72 in acetone was applied to all the broken surfaces. This intermediary film serves as a protective barrier, preventing direct chemical interaction between the original ceramic substrate and the adhesive. A two-part epoxy resin (UHU) was selected for the primary bond due to its mechanical strength and extended working time of approximately 90 minutes. This property enabled careful positioning and alignment of each fragment without the risk of premature setting. The epoxy was applied precisely along the prepared edges, ensuring a uniform distribution and avoiding excess accumulation that could compromise aesthetics or stability. The choice of conservation-grade materials was limited in Thailand; access to those materials is more commonly found in Europe.

Each leg was reattached sequentially, beginning with the most structurally essential point. Stabilisation during curing was achieved using a buckle strap clamp, with thin Ethafoam inserts placed between the clamp and the ceramic surface to buffer pressure and prevent abrasions (Fig. 42 and 43). After alignment, the joints were left undisturbed overnight to ensure optimal bond strength during the entire curing period. This process was repeated for each detached element, allowing for accurate structural integration without imposing undue stress on previously treated areas.



Figure 42 : Before joining.



Figure 43 : After joining.

5.5. Filling

Filling was undertaken to address areas of material loss and to reinforce structurally incomplete joins, particularly around the leg and tail attachments of *Textured Dog*. The objective was to restore physical continuity and improve the mechanical stability of previously reattached components without compromising the aesthetic or structural integrity of the object.

A customised fill material was prepared using a modified mixture of epoxy putty (Alteco), marble dust, and dry pigments matched to the clay body's colour tone (Fig. 44). This combination was selected for its favourable properties, including high compressive strength, good adhesive compatibility with the ceramic surface, and the ability to achieve a visual appearance compatible with the exposed ceramic substrate.



Figure 44 : Close-up of fill.

The fills were carefully applied to bridge gaps at the reattachment points, particularly where minor losses at the break edges had resulted in small voids or unstable contact zones. Sculpting tools and dental wax sheets were used to shape the fills in situ (Fig. 45), and their surfaces were smoothed before curing to match the surrounding texture. The treatment provided additional reinforcement to vulnerable areas while supporting the visual coherence of the reassembled structure.



Figure 45 : Using dental wax sheet to match the shape prior to filling.

5.6. Protective coating

A localised protective coating of Paraloid B-72 was applied to areas where fills had been introduced during the structural stabilisation process of the sculpture. This acrylic resin, well established in conservation practice for its stability and reversibility, was chosen to enhance the visual integration of the filled areas while providing added protection to the newly treated surfaces (Koob 1986).



Figure 46 : Close-up of application of protective coating.

The coating provided a glossy finish that visually harmonised the matte surface of the epoxy-based fills with the surrounding glazed ceramic, enhancing aesthetic continuity (Fig. 46 and 47). Additionally, it served as a protective barrier against environmental pollutants, ultraviolet rays, and moisture infiltration, all of which could



Figure 47 : Close-up of the application of protective coating.

compromise the long-term stability of the material used for filling. The application also pre-emptively addressed the potential yellowing of epoxy putty over time by creating an isolating layer that minimized visual change. This treatment contributed both functionally and aesthetically to the overall conservation strategy, supporting the sculpture's long-term preservation.



Figure 48: Before the conservation of Textured Dog.



Figure 49 : After the conservation of Textured Dog.



6. Care and Maintenance Protocols for Storage and Exhibition of Textured Dog

Textured Dog necessitates a detailed set of preventive conservation measures during storage to ensure its long-term stability. Given the object's porous ceramic body, glazed surface, specific environmental control, housing design, handling protocols, and regular monitoring, measures must be implemented.

6.1. Customised storage and transportation box

A central component of the preventive conservation strategy for *Textured Dog* involved the development of a custom-designed storage and transportation box (Fig. 50). This specialised housing solution was created with a dual focus: to ensure the physical safety of the sculpture and to facilitate ergonomic, sustainable handling throughout its life cycle. The sculpture's considerable weight of 60 kilograms, combined with its fragile glazed surface, requires a storage system that could address both structural demands and conservation priorities.



Figure 50 : Concept design for the transportation box.

The outer structure of the box, especially the sides and top, was constructed from archival-quality birchwood, chosen for its inert nature and structural stability. To balance durability with portability, the design incorporated thinner wood panels, especially the front and back, with the help of foldable plywood. This choice effectively reduced the overall weight of the enclosure while still providing sufficient mechanical strength. In contrast, the base was constructed from a significantly thicker teakwood panel to support the sculpture's weight without risk of deformation, warping, or collapse. This configuration provided a robust and stable platform (Fig. 51), ensuring that both storage and transportation could occur without compromising the object's structural integrity.



Figure 51 : Outer structure of the box.

A key component of the design was the inclusion of an interchangeable front panel, which could be replaced with a transparent acrylic sheet as requested by the art director. This feature enabled continuous visual monitoring of the sculpture while it remained fully enclosed, eliminating the need for frequent handling (Fig. 52 and 53). During transportation, the box was covered from all sides to prevent visibility of the object inside (Fig. 54). This was especially important for scenarios involving long-term storage, as it significantly reduced the risk of accidental damage during periodic condition checks.



Figure 52 : Close-up of acrylic panel in front attached using iron nails (see marked circles in red).



Figure 54 : Textured Dog viewed from the front through attached acrylic panels.



Figure 53 : Closed box using foldable plywood and iron nails.

All external wooden panels were constructed with an interlocking jigsaw design with grooves, enabling quick assembly, disassembly, and reuse in different contexts. Thin aluminium sheets were inserted between the grooves of the side and top panels to enhance grip and ensure a precise fit (Fig. 55). For the base, wooden inserts were used to provide additional support for loads exceeding 60 kilograms, especially once the base was secured using a reversible adhesive. The entire enclosure was designed to be screw-fastened using regular manual or automatic screwdrivers, making it fully modular and easy to reconfigure or adapt. This modularity supports sustainable conservation practices by allowing components to be reused or modified for future storage or transportation needs (Museums & Galleries Commission 1992).



Figure 55 : Close-up of interlocking jigsaw design using grooves.

The internal structure of the box was meticulously designed to ensure effective shock absorption and mechanical support. A thin layer of flexible foam was applied to the interior base, which was then overlaid with a high-density Ethafoam sheet. This sheet was custom-cut to fit the legs of the sculpture precisely using a hot knife foam cutter, thereby distributing its weight evenly and preventing undue stress on any single area (Fig. 56). The internal foam padding system was created to absorb minor vibrations or shocks that might occur during transit, movement, or handling. Furthermore, additional dense foam supports were strategically positioned prior to transportation, to stabilize structurally vulnerable areas, particularly the legs and tail, which had previously undergone interventive conservation treatments and were considered highly susceptible to stress-related damage.



Figure 56 : Close-up of Ethafoam custom-cut to fit legs of Textured Dog.

To prevent lateral or rotational movement during transport, square Ethafoam long inserts were to be positioned between the sculpture and the internal walls of the box prior to transportation. These inserts would help create a snug yet cushioned enclosure, maintaining a stable and secure environment throughout handling or relocation. The inclusion of such features is in line with best practices in preventive conservation for three-dimensional ceramic objects, ensuring minimal movement without direct pressure on the object's surface (Getty GCI).

To further enhance mobility and safe handling, heavy-duty wheels with a lockable mechanism were affixed to the bottom of the box (Fig. 57). These allowed the structure to be moved smoothly across gallery floors or storage facilities while enabling the securing of stationary positioning when required.



Figure 57: Close-up of locking wheels system.

A space was allocated within the enclosure to house essential conservation documentation. This would include all the paperwork pertaining to the sculpture, such as condition reports, photographic records, material data sheets, and handling instructions. Keeping such records physically associated with the object helps to avoid dissociation and ensure continuity in conservation care and interpretation during any future exhibition or loan (Canadian Conservation Institute [CCI] 2017). If the sculpture is temporarily removed from its storage box, it should remain grouped with the other seven dogs comprising the original installation to maintain contextual integrity and prevent dissociation. The entire installation should be covered with Tyvek sheeting or unbleached cotton fabric, both of which provide a breathable barrier that protects the surface from dust accumulation, minimising the risk of abrasion.

This customised housing solution serves as a comprehensive preventive conservation measure. It provides mechanical stability, facilitates ongoing condition monitoring, and supports sustainable, ergonomic object care. Most importantly, it complements earlier interventive treatments, ensuring that the sculpture remains both protected and accessible. By mitigating the potential risks associated with physical handling, environmental stress, and transportation, the storage box design contributes to the long-term preservation of the sculpture.

6.2. Preventive measures for long-term storage

6.2.1. Environmental control

To ensure the long-term stability of *Textured Dog* ceramic sculpture, environmental conditions should prioritise stability over narrowly fixed values. According to current international conservation standards (CCI 2020; IIC/ICOM-CC 2023), the recommended temperature range is 16 - 25°C, with an optimal relative humidity (RH) maintained between 45 – 55%. Short-term fluctuations in RH should not exceed $\pm 10\%$ over a 24-hour period, as the porous ceramic body is particularly sensitive to repeated moisture expansion and contraction. Such cycles may lead to microfracturing or surface deterioration, especially in the presence of soluble salts (Lins and Sozzani 2022).

Until further notice, the sculpture and the other seven dogs of the installation will be placed in a dehumidified storage room. This environment helps maintain RH within the

preferred range and reduces the risk of salt crystallisation, mould growth, and pollutant accumulation. Adequate ventilation is maintained to prevent condensation and inhibit the build-up of airborne particulates. The object is supported using archival-quality materials to minimise chemical reactivity and mechanical stress during its period in storage. The customised wooden container includes three air holes spaced out on the lower left and right sides to ensure proper ventilation within the box, preventing the formation of an isolated microclimate.

6.2.2. Handling protocols and monitoring

The handling of *Textured Dog* should be strictly limited to trained personnel wearing nitrile gloves to prevent the transfer of skin oils or moisture, both of which can contribute to surface staining (Canadian Conservation Institute 2018). Biannual inspections are recommended to evaluate the condition of the sculpture and should be conducted in conjunction with the evaluation of the remaining seven dogs that form the complete installation. Assessing the artwork as an integrated whole enables a more comprehensive understanding of shared deterioration patterns and supports the implementation of cohesive conservation measures for the entire ensemble.

Each inspection should be thoroughly documented, including photographic records, environmental data, observable changes in condition, and any modifications made to storage or treatment protocols. This ongoing documentation process is vital for sustaining a long-term conservation strategy, ensuring the continued accessibility and structural integrity of the sculpture and its associated components.

6.2.3. Light protection

To safeguard the ceramic sculpture from photodegradation, storage conditions must maintain light levels between 0 and 50 lux, with complete darkness preferable when the object is not being actively viewed. Such reduced exposure significantly limits cumulative light damage, particularly to vulnerable surface features such as glazes, pigments, or previously applied organic treatments.

In exhibition settings, where installations are intended for public display, lighting conditions must be carefully regulated. Although the ceramic body itself is generally robust and considered low in light sensitivity, surface treatments, such as glazes, may be susceptible to deterioration over time due to cumulative light exposure. As such, recommended light levels should not exceed 150 to 200 lux for ceramic objects, with ultraviolet (UV) radiation strictly limited to below 75 $\mu\text{W}/\text{lumen}$, in accordance with internationally recognised museum standards (Thomson 2002; Canadian Conservation Institute 2020). These controls help prevent fading, discolouration, or structural weakening of sensitive decorative elements. Therefore, careful environmental control

is essential to ensure both long-term preservation and safe public presentation of the installation.

Conclusion

The conservation of *Textured Dog* has offered not only a practical resolution to the deterioration of a contemporary ceramic sculpture but also a valuable case study in the treatment of outdoor ceramics in Southeast Asia.

Working with an object that is both sculptural and functional, a dog-shaped lounge chair designed for children raised specific conservation considerations that extended beyond technical repair. The sculpture's playful, tactile nature and public accessibility emphasised the importance of preserving not just the object's material integrity but also its interactive and social intent. Every intervention had to respect the artist's vision, the context of the installation, and the object's cultural relevance within the broader narrative of Thai ceramic art.

The process also revealed the limits and possibilities of conservation practice within a regional setting. The availability of suitable materials, institutional support, and the realities of Thailand's climate shaped the practical decisions made throughout the project. The adaptation of available resources reflected the necessary flexibility in conservation work. In this respect, the project served as a model for pragmatic, yet rigorous conservation under real-world conditions.

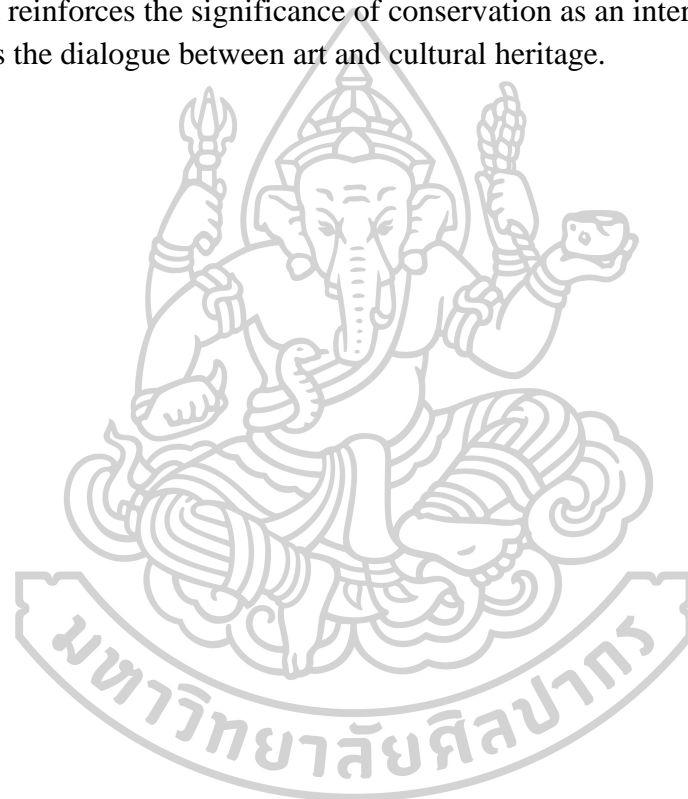
This thesis presented the conservation of *Textured Dog* by Thanatnoond Kumprommarat as a case study in the preservation of contemporary ceramics. The project addressed both structural and surface deterioration resulting from prolonged environmental exposure. Guided by a detailed condition assessment, targeted conservation treatments were carried out with sensitivity to the artist's intent and materials. Preventive strategies, including the development of a custom storage and transportation solution, were also implemented to support the sculpture's long-term preservation. The successful treatment of this individual piece offers a model for the future conservation of the remaining seven sculptures in the *Textured Dog* installation.

One of the lasting outcomes of this thesis is the design and fabrication of a supportive transportation and storage solution. This forward-looking measure addresses not only the immediate needs of the object's recovery but also the long-term requirements for safe housing, future reinstallation, and preventive conservation. The inclusion of care protocols reflects a growing recognition that conservation is not a singular intervention but a continuous cycle of monitoring, adaptation, and maintenance.

On a broader level, this work contributes to the field by documenting a methodology for the conservation of contemporary ceramic artworks exposed to tropical outdoor

conditions, a topic that remains underrepresented in current literature. It highlights the importance of object-focused research, interdisciplinary collaboration, and the thoughtful application of conservation science to preserve the tangible and intangible qualities of contemporary heritage.

In conclusion, this thesis affirms that conservation is a dynamic practice shaped by material realities, environmental context, and cultural meaning. It calls for conservators to act as both technicians and interpreters, carefully balancing the demands of preservation with the values embedded in the artworks themselves. The conservation of *Textured Dog* extends beyond the physical restoration of a damaged sculpture; it reinforces the significance of conservation as an interdisciplinary practice that sustains the dialogue between art and cultural heritage.




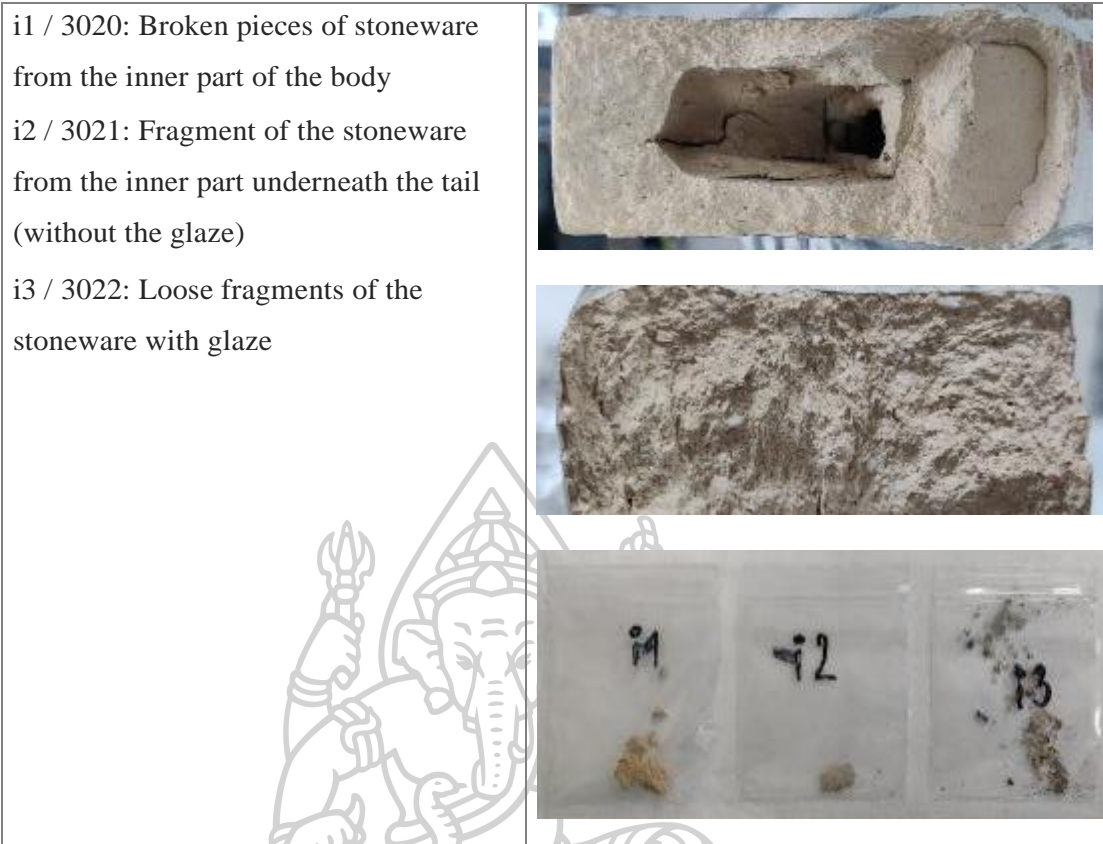
Appendix I: Scientific investigations

The complete documentation of the examination and scientific analysis conducted on the *Textured Dog* sculpture is provided below.

All the investigations were conducted by Dr. Tatjana Bayerova and Dr. Farkas Pinter, at the Institute of Conservation, University of Applied Arts Vienna.

SAMPLE DATASHEET

SAMPLING	
NAME	DATE
Isha A Mukherjee	18 November 2024
PROJECT INFO	SAMPLE NUMBERS / IoC NUMBERS
Master thesis	i1 / 3020 i2 / 3021 i3 / 3022
OBJECT INFO	
INVENTORY Nr.	COLLECTION
–	Sanam Chandra Art Gallery, Visible Storage, Art Centre Silpakorn University
TITLE/DESCRIPTION	ARTIST
“Textured dog” (Garden Seat)	Thanatnoond Kumprommarat
TYPE OF OBJECT	PHOTO OF THE OBJECT
Glazed stoneware sculpture	
SAMPLES' DESCRIPTION and SAMPLING LOCATION	



QUESTIONS

- What is the composition of the stoneware?
- What is the composition of the glaze?
- Other findings helpful for the technology clarification?

LABORATORY INVESTIGATION³⁰

METHODS APPLIED

- Optical microscopy in incident light
- Scanning electron microscopy with energy-dispersive X-ray analysis (SEM-EDS)
- XRD

EXPERIMENTAL

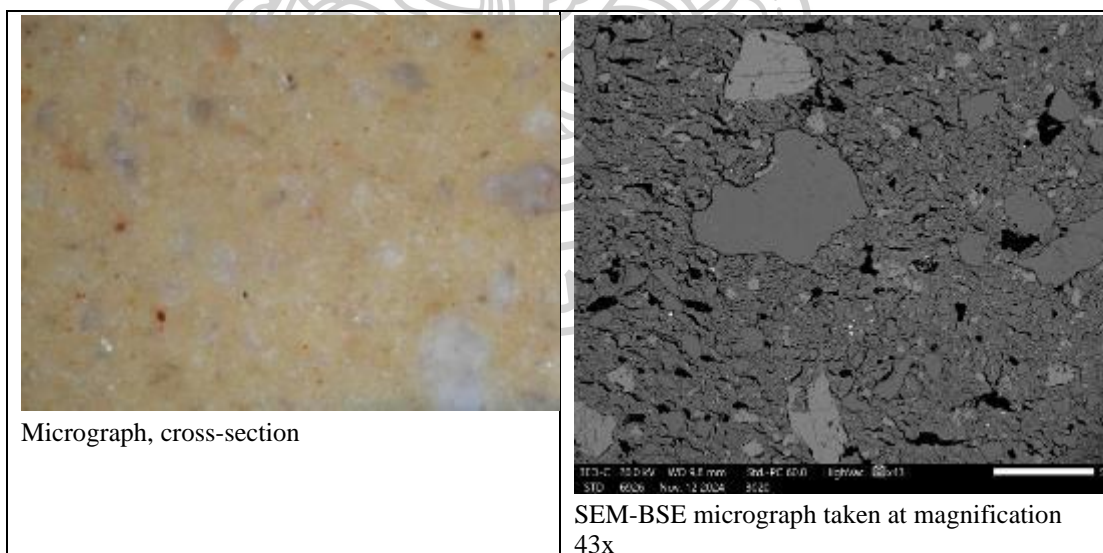
After the initial observation under a stereomicroscope, some sample fragments were used for preparation of cross-sections by embedding them in the epoxy resin Araldite® 2020 (Huntsman Corporation), followed by dry grinding and polishing.

The light microscopy of the cross-sections was performed in visible reflected light using a Nikon Eclipse ME 600 microscope equipped with a Nikon D300 digital camera. Furthermore, the cross-sections were examined by SEM-EDX under high vacuum using a scanning electron microscope Mira3 LMU, Tescan. Elemental analyses of the individual phases and particles were carried out with a scanning electron microscope JEOL JSM-IT200 fitted with a JEOL SDD EDX detector; the samples were vapor-coated with carbon prior to the measurements.

Legend to the SEM-EDS-elemental analysis: element in underlined letters – main element, element in brackets – minor element (low content), element in double brackets – trace element.

RESULTS

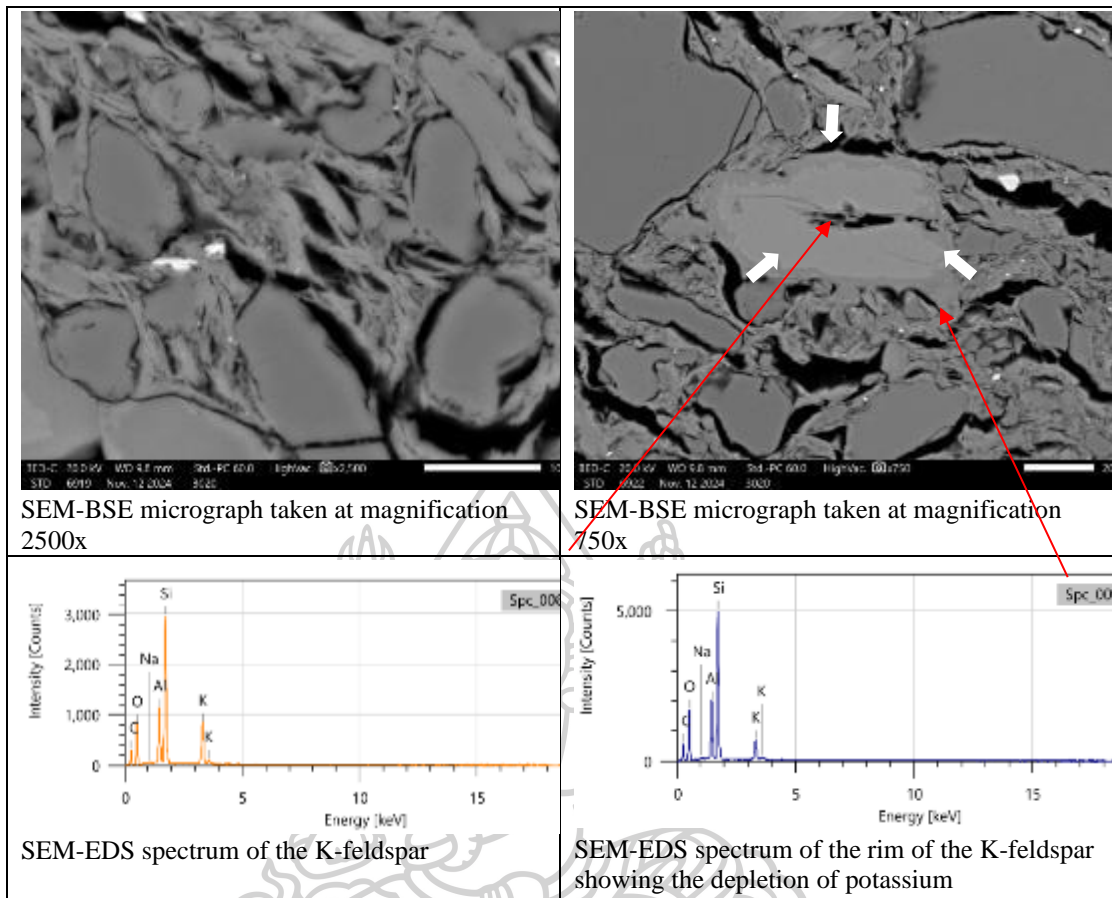
i1 / 3020: Broken pieces of stoneware from the inner part of the body



Micrograph, cross-section

SEM-BSE micrograph taken at magnification 43x

³⁰ The investigations were carried out by Dr. Tatjana Bayerova and Dr. Farkas Pintér, Institute of Conservation (headed by o. Univ.-Prof. Mag. Dr. Gabriela Krist), University of Applied Arts Vienna



As seen in the micrograph taken by the optical microscope, the ceramic body exhibits a light beige colour. The body consists of a clay matrix primarily composed of aluminosilicates with the elemental composition Si, Al, K, and Fe, indicating the use of a kaolinitic clay with iron-oxide as an impurity. The yellowish-light beige discolouration may be attributed to the low amounts of iron oxides and slightly reducing conditions during the firing. The clay matrix is tempered with quartz and feldspar grains. The average grain-size distribution of the temper varies between 50 and 100 μm , the largest grains are up to 800 μm in size. The stoneware is medium-porous and locally partially sintered (the structure of the clay is still visible), exhibiting numerous shrinkage cracks parallel to the surface. The role of alkali feldspars as a flux can be well observed in the SEM-BSE images: partial depletion of potassium and additional lowering of the melting point of the surroundings of K-feldspar led to the formation of local melts and the strengthening of the ceramic body (see SEM-EDS spectra and arrows).

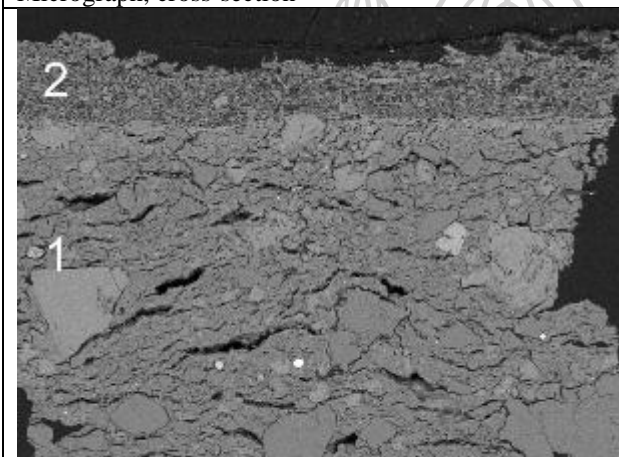
i2 / 3021: Fragment of the stoneware from the inner part underneath the tail (without the glaze)



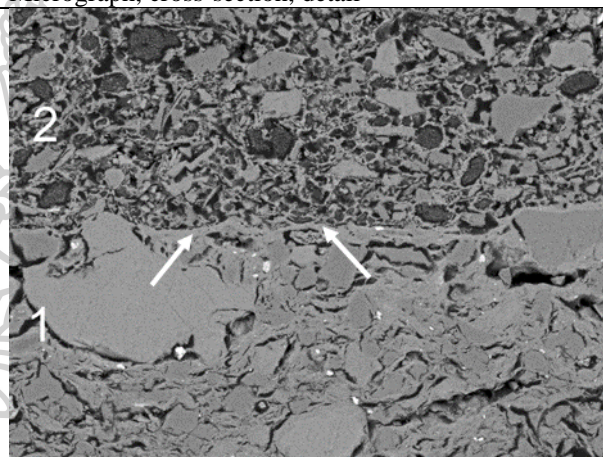
Micrograph, cross-section



Micrograph, cross-section, detail

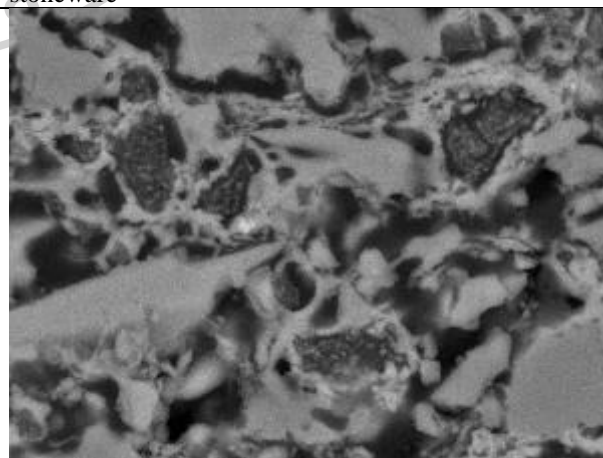
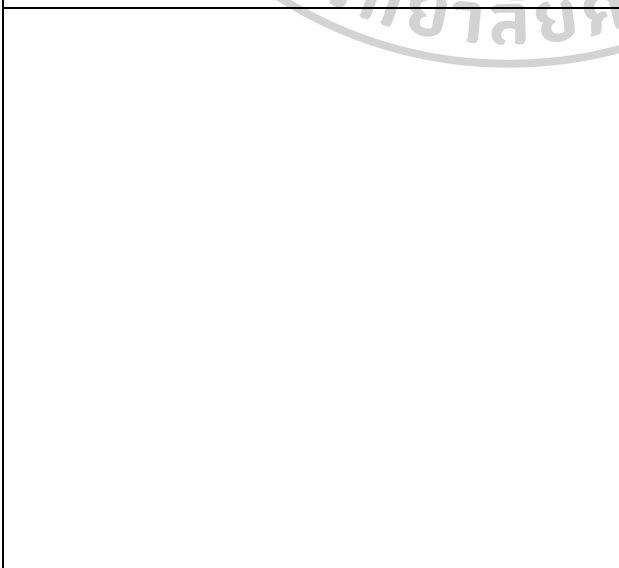


SEM-BSE micrograph taken at magnification 200x



SEM-BSE micrograph taken at magnification 1,000x, detail

White arrows mark the surface of the sintered stoneware



SEM-BSE micrograph taken at magnification 5,000x, detail of the sintered slip (Nr. 2)

As seen in the cross-section micrograph, the stoneware (Nr. 1) is light beige in colour, with a white slip (Nr. 2) applied over it.

The stoneware (Nr. 1) consists of a clay matrix primarily composed of aluminosilicates with the elemental composition Si, Al, K, and Fe, indicating the use of a kaolinitic clay coloured by iron oxides. The clay matrix is tempered with quartz and feldspar grains up to 200 μm in size. The stoneware is medium-porous and lightly sintered (the structure of the clay is still visible), exhibiting numerous shrinkage cracks parallel to the surface. On the surface, a compact layer (indicated by white arrows in the SEM-BSE micrograph) likely formed during the initial firing of the stoneware, before the application of the white slip. For more precise analysis of clay, X-ray diffraction is needed.

The white slip (Nr. 2) contains fine silica particles (SiO_2) and sheet silicates (Si, Mg) with grain size up to 30 μm , used as tempering materials, embedded in a clay matrix with the elemental composition Si, Al, Ca, and Mg. The difference in elemental composition suggests that different types of clay were used for the stoneware and the slip. The clay is tempered with feldspars, the elemental composition Si, Al, Ca, and K. The white slip is finer-grained, more sintered, and more porous than the stoneware.

Slip – is primarily composed of clay, though it often has small amounts of flux; this helps keep it adhered to the surface of a clay form during the firing.

Temper – a non-plastic material added to clay to prevent shrinkage and cracking during drying and firing of clay in order to achieve both hardness and flexibility, which equals strength.

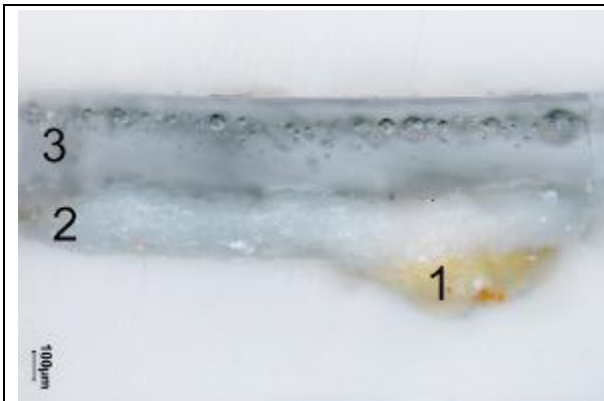
A fluxing agent (or softening agent) is required to lower the sintering temperature and save energy in the powder sintering method. Feldspars are used as fluxing agents to form a glassy phase at low temperatures and as a source of alkalis and alumina in glazes.

Feldspar, any of a group of aluminosilicate minerals that contain calcium, sodium, or potassium

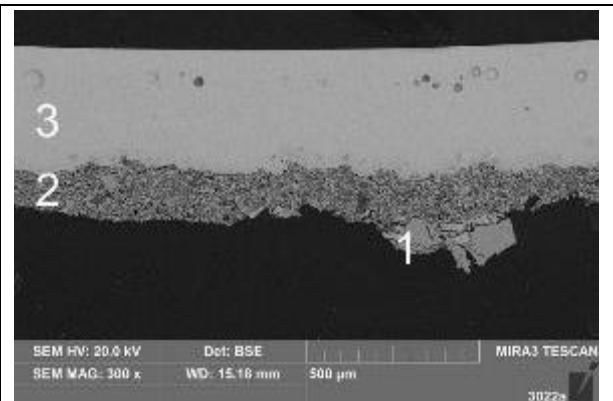
i3 / 3022: Loose fragments of the stoneware with glaze

Fragment A – stoneware with “white glaze”

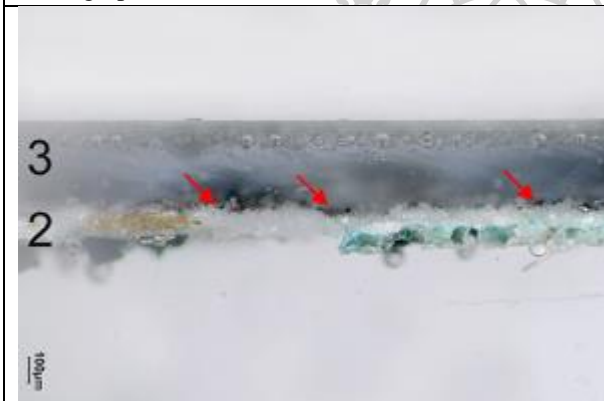
Fragment B – stoneware with “black glaze”



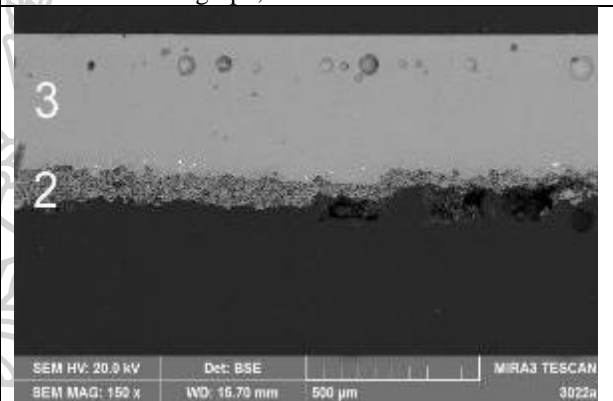
Micrograph, cross-section A



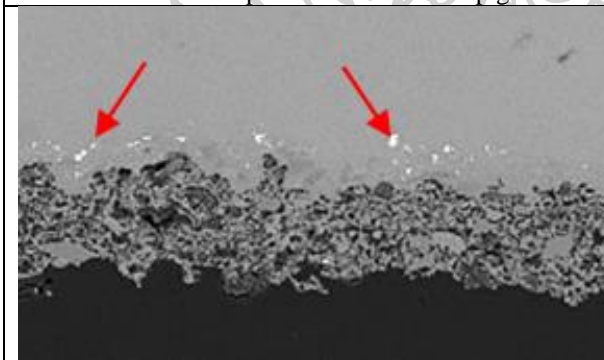
SEM-BSE micrograph, cross-section A



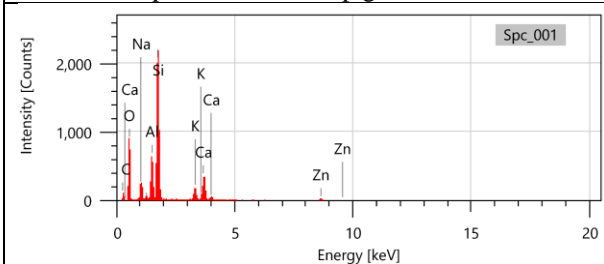
Micrograph, cross-section B
The arrows mark the particles of the black pigment



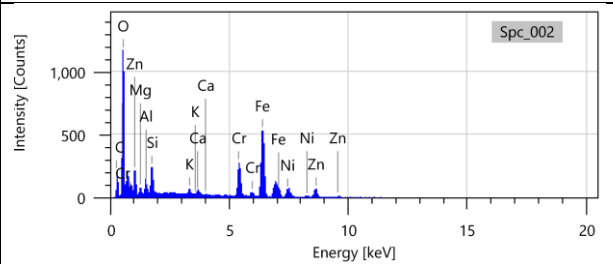
SEM-BSE micrograph, cross-section B, taken at magnification 150x



SEM-BSE micrograph, cross-section B,
detail of the particles of black pigment



SEM-EDS spectrum of the glaze



SEM-EDS spectrum of the black pigment

Fragment A with the transparent glaze consists of the beige stoneware (Nr. 1), white slip (Nr. 2) and a transparent, not coloured glaze (Nr. 3).

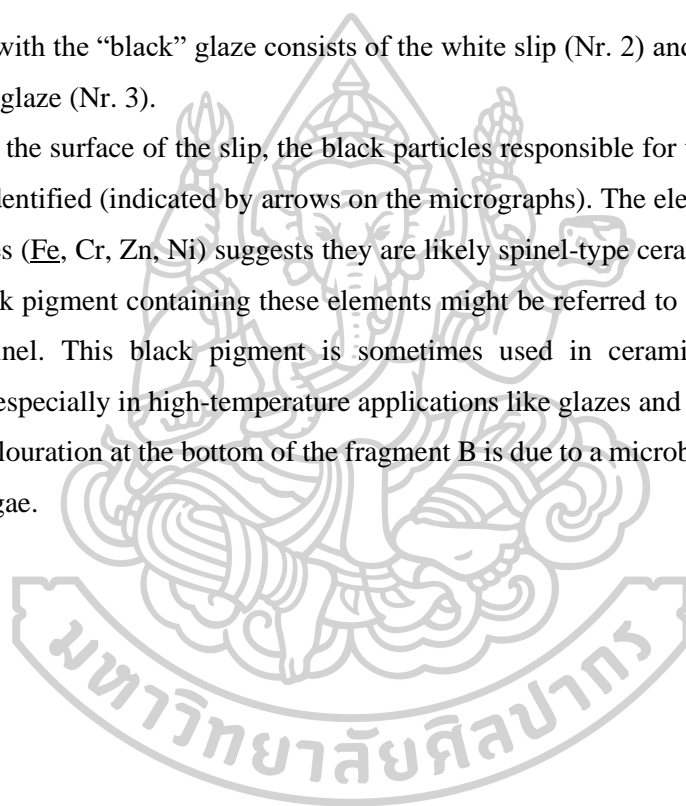
Based on its elemental composition (Si, Al, Ca, Na, K, Zn (Mg)), the glaze can be classified as a typical lime-alkaline glaze. Lime-alkaline glazes are popular for their combination of gloss, clarity, and strength.

The presence of zinc in the glaze likely originates from zinc oxide, which was added during production. Zinc oxide enhances the texture, colour, and appearance of the glaze, making it an important component for achieving desired artistic effects.

Fragment B with the “black” glaze consists of the white slip (Nr. 2) and the same transparent, not coloured glaze (Nr. 3).

However, on the surface of the slip, the black particles responsible for the black colour of the glaze were identified (indicated by arrows on the micrographs). The elemental composition of these particles (Fe, Cr, Zn, Ni) suggests they are likely spinel-type ceramic black pigments. A possible black pigment containing these elements might be referred to as a nickel-chromium-iron-zinc spinel. This black pigment is sometimes used in ceramics for black or grey colouration, especially in high-temperature applications like glazes and enamel coatings.

The green colouration at the bottom of the fragment B is due to a microbiological attack, likely caused by algae.




Appendix II: Product data sheets

Acetone³¹



Safety Data Sheet

Section 1 Identification		
Product Name	Acetone	Version: 8 Effective Date: 25 January 2021
Other Means Of Identification	2-Propanone	
Initial Supplier Identifier	Chemfax Products Ltd. 11444 – 42 Street SE Calgary, AB T2C 5C4 Tel: 403-287-2055	
Recommended Use and Restrictions On Use	Industrial Solvent. No restrictions.	
Product Family	Solvent	
Emergency Phone	1-855-887-2055 Monday - Friday 8:00am - 4:30pm MST	

Section 2. Hazard Identification	
Hazard Classification	
Physical Hazard	Flammable Liquids – Category 2
Health Hazard	Skin Corrosion/Irritation - Category 2 Eye Damage/Irritation - Category 2A Specific Target Organ Toxicity (Single Exposure) - Category 3
Signal Word	Danger!
Hazard Statement	Highly flammable liquid and vapour. Causes skin irritation. Causes serious eye irritation. May cause respiratory irritation; or may cause drowsiness or dizziness.
Precautionary Prevention Statement	Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Keep container tightly closed. Ground and bond container and receiving equipment. Use explosion proof electrical, ventilating and lighting equipment. Use non-sparking tools. Take action to prevent static discharges. Wear protective gloves, clothing, eye and face protection. Wash hands thoroughly after

³¹ Chemfax. *Acetone: Safety Data Sheet*, Version 8 (2021). Accessed on August 1, 2025. <https://chemfax.com/wp-content/uploads/2020/12/Acetone-SDS-Version-8-2021.pdf>.



Safety Data Sheet

	<p>handling. Do not breathe dust, fume, gas, mist, vapours or spray. Use only outdoors or in a well-ventilated area. Do not eat, drink or smoke when using this product.</p> <p>Obtain special instructions before use. Do not handle until all safety precautions have been read and understood.</p>
Precautionary Response Statement	<p>IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse and wash skin with water or shower if on clothing. In case of fire: Use foam, carbon dioxide, dry chemical to extinguish. If skin irritation occurs: Get medical attention. Take off contaminated clothing and wash it before reuse.</p> <p>IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical attention.</p> <p>IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a doctor if you feel unwell. Get medical attention if you feel unwell.</p>
Precautionary Storage Statement	Store in a well-ventilated place. Keep cool. Keep container tightly closed. Store locked up.
Precautionary Disposal Statement	Dispose of contents/container in accordance to local regulations.

Section 3. Composition / Information on Ingredients

Chemical Name	Common Name or Synonyms	CAS No. and Other Unique Identifiers	% by weight
Acetone	2-propanone;	67-64-1	100

Section 4. First-Aid Measures

Eye Contact	Flush eyes with water for 15 minutes. Seek medical attention.
Skin Contact	Flush area with water. If skin is damaged seek immediate medical attention. If irritation persists seek medical attention. Launder clothing before reuse.
Inhalation	Remove victim to fresh air. If there is difficulty breathing, seek immediate medical attention.
Ingestion	Do not induce vomiting. Lay victim on left side to prevent aspiration of any vomit. Seek immediate medical attention.
Most Important Symptoms and Effects Both Acute and Delayed	Irritation. Headache. Nausea. Shortness of breath.



Safety Data Sheet

Immediate Medical Attention and Special Treatment	Treat symptomatically
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Section 5. Fire-Fighting Measures	
Suitable and Unsuitable Extinguishing Media	Foam, carbon dioxide, dry chemical. Water may be ineffective.
Hazardous Combustion Products	Carbon monoxide
Specific Hazards Arising From the Product	Decomposition at elevated temperatures releases oxides of carbon.
Special Protective Equipment and Precautions For Fire-Fighters	Fire-fighters should wear self contained breathing apparatus and full protective clothing. Use water spray to cool containers and structures exposed to fire. May ignite if static discharge.

Section 6. Accidental Release Measures	
Personal Precautions, Protective Equipment and Emergency Procedures	Gloves (neoprene), goggles or face shield, coveralls (flameproof), footwear appropriate for worksite. Air purifying respirator (organic vapours / mists) if exposure limits are being exceeded. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing vapor or mist. Provide adequate ventilation.
Environmental Precautions	Do not allow to enter any surface water courses or drains and sewers. Product may collect in low places. Remove all sources of ignition and naked flames.
Methods and Materials for Containment and Clean-Up	With all sources of ignition removed and wearing correct protective apparel, close area and remove all personnel not required for clean up. Pump up large volumes of product, or soak up smaller amounts with an absorbent. Place collected material in a suitable container for disposal. Wash area down with soap and water to remove residues.

Section 7. Handling and Storage	
Precautions For Safe Handling	Handle with care. Flammable liquid. Containers should be grounded to prevent static discharge.
Conditions For Safe Storage	Store in a cool dry place away from any sources of ignition.



Safety Data Sheet

Section 8. Exposure Controls / Personal Protection				
Control Parameters	TWA: 8 Hr	STEL: 15 min	Ceiling	IDLH*
Acetone	2400 ppm OSHA	750 ppm ACGIH		
* Immediately Dangerous to Life and Health				
Exposure Controls	Local exhaust ventilation to maintain exposure levels below legal limits.			
Appropriate Engineering Controls	Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.			
Individual Protective Measures				
Eye / Face Protection	Goggles			
Skin Protection	Chemical resistant gloves, coveralls			
Respiratory Protection	Air purifying respirator fitted with cartridges (organic vapours / mists) must worn if exposure limits are being exceeded.			

Section 9. Physical and Chemical Properties	
Appearance	Clear, colourless liquid
Odour	Sweet
Odour Threshold	Not available.
pH	7
Flash Point	-17 °C
Boiling Point and Boiling Range	56 °C
Melting Point and Freezing Point	-94 °C
Evaporation Rate	5.6 – 6.06 (ASTM D 3539)
Flammability (solid, gas)	Not applicable
Upper and Lower Flammability or Explosive Limits	2% to 13%
Vapour Pressure	231 mmHg @ 25 °C
Vapour Density	2.0 (air =1) @ 20 °C
Relative Density	0.792 @ 20 °C
Solubility	Completely soluble in water



Safety Data Sheet

Partition co-efficient, n-Octanol/Water	Log Pow: -0.24
Auto Ignition Temperature	465 °C
Decomposition Temperature	No data
Viscosity	0.32 mPa.s @ 25 °C

Section 10. Stability and Reactivity	
Reactivity	No dangerous reaction known under conditions of normal use
Chemical Stability	Stable
Possibility of Hazardous Reactions	Will not occur
Conditions to Avoid	Open flames and sources of ignition
Incompatible Materials	Strong oxidising agents. Strong reducing agents.
Hazardous Decomposition Products	Not expected to decompose under normal conditions of use.

Section 11. Toxicological Information			
Component Toxicity	LD50 Oral	LD50 Dermal	LC50 Inhalation
Acetone	5.2 g/kg (Rat)	>7.426 g/kg (Rat)	76 ppm (Rat), 4h
Likely Routes of Exposure			
Skin:	May cause mild irritation.		
Eyes:	May cause irritation. Symptoms may include – burning, redness, swelling, tearing and blurred vision.		
Inhalation:	Not classified.		
Ingestion:	Not classified		
Acute Toxicity Estimates (ATE)	Acute Toxicity (Oral LD50): mg/kg (oral rat) 5800 Acute Toxicity (Inhalation LC50): mg/l (vapours) (8h) 50100 Acute Toxicity (Dermal LD50): mg/kg Rabbit 20000		
STOT (Specific Target Organ Toxicity) – Single Exposure	May cause drowsiness or dizziness		
Aspiration Toxicity	Not classified		
STOT (Specific Target Organ Toxicity) – Repeated Exposure	Not classified		



Safety Data Sheet

Skin Corrosion / Irritation	Prolonged or repeated contact can defat the skin and lead to irritation, cracking and/or dermatitis.
Serious Eye / Irritation	Causes eye irritation.
Respiratory or Skin Sensitization	Not classified
Carcinogenicity	not classified as human carcinogen.
Reproductive Toxicity	
- Sexual Function and Fertility	Not classified
- Development of Offspring	Not classified
- Effects on or via Lactation	Not classified
Germ Cell Mutagenicity	Not classified.
Interactive Effects	None known
Other Information	None known

Section 12. Ecological Information	
Ecotoxicity	LC50 (Oncorhynchus mykiss (rainbow trout)): 6,100 mg/l, 48h
Persistence and Degradability	Will not persist
Bioaccumulative Potential	Particioning coefficient log Pow: -0.24
Biodegradability	Readily biodegradable. Oxidises by photo-chemical reactions in air.
Mobility in Soil	No data
Other Adverse Effects	None known

Section 13. Disposal Considerations	
Disposal Considerations	Dispose of contents / container in accordance with local regulations.

Section 14. Transport Information	
UN Number	1090
UN Proper Shipping Name	Acetone
Transport Hazard Class(es)	3
Packaging Group	II
Environmental Hazards	Not applicable
Bulk Transport	Not applicable



Safety Data Sheet

Special Precaution	Not applicable
DOT Erg#	130


Section 15. Regulatory Information	
Canada – DSL Inventory	All components of this product are either on the Domestic Substances List (DSL) or Non-Domestic Substances List (NDSL) or exempt
TSCA	All components of this product are either on the Toxic Substances Control Act (TSCA) Inventory List or exempt
Additional Information	None

Section 16. Other Information	
NFPA Rating	Health-2/ Flammability-3/Reactivity-0/Special Hazard-Not applicable
HMIS Rating	Health-2/Flammability-3/Reactivity-0/Personal Protection-See Section 8.
Prepared by:	Chemfax Products Ltd., Technical Department
Date Prepared:	
Date of Latest Revision:	25 January 2021
Disclaimer	
Notice to reader	
<p>To the best of our knowledge, the information contained herein is accurate. However, neither the above named supplier nor any of its subsidiaries assumes any liability whatsoever for the accuracy or completeness of the information contained herein. Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.</p>	
<p>Chemfax Products Ltd. expressly disclaims all expressed or implied warranties of merchantability and fitness for a particular purpose with respect to the product provided.</p>	

Ethanol³²

Safety Data Sheet

Section 1. Identification		
Product Identifier	Ethyl Alcohol	Version: 5 Effective Date: 25 January 2021
Other Means Of Identification	Ethanol	
Initial Supplier Identifier	Chemfax Products Ltd. 11444 – 42 Street SE Calgary, AB T2C 5C4 Tel: 403-287-2055	
Recommended Use and Restrictions On Use	Solvent. No restrictions	
Product Family	Alcohol	
Emergency Phone	1-855-887-2055 Monday - Friday 8:00am - 4:30pm MST	

Section 2. Hazard Identification	
Hazard Classification	
Physical Hazards	Flammable Liquids - Category 2
Health Hazards	Acute Toxicity – Category 3 Eye Damage / Irritation – Category 2A Specific Target Organ Toxicity (single exposure) – Category 1
Signal Word	Danger
Hazard Statement	Highly flammable liquid and vapour. Toxic if swallowed. Causes serious eye irritation. Causes damage to organs liver, nerves, and heart.
Precautionary Prevention Statement	Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Keep container tightly closed. Use non-sparking tools. Ground and bond container and receiving equipment. Take action to prevent static discharge. Use explosion proof electrical, ventilating and lighting equipment. Wear protective gloves, clothing, eye and face protection. Wash hands thoroughly after handling. Do not eat, drink or smoke when using this product.

³² Chemfax. *Ethyl Alcohol: Safety Data Sheet, Version 5 (2021)*. Accessed on August 1, 2025. <https://chemfax.com/wp-content/uploads/2020/12/Ethyl-Alcohol-SDS-Version-5-2021.pdf>.



Safety Data Sheet

	Do not breathe dust, fumes, gas, mist, vapours or spray.
Precautionary Response Statement	<p>IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water.</p> <p>IF SWALLOWED: Immediately call doctor. Rinse mouth.</p> <p>IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical attention.</p> <p>If exposed or concerned: Call a doctor.</p> <p>Specific treatment do not induce vomiting unless directed by medical personnel.</p> <p>In case of fire: Use alcohol resistant foam to extinguish</p>
Precautionary Storage Statement	Store in a well- ventilated place. Keep cool. Store locked up.
Precautionary Disposal Statement	Dispose of contents / container in accordance with local regulations.
Other Hazards	None

Section 3. Composition / Information on Ingredients

Chemical Name	Common Name or Synonyms	CAS NO. and Other Unique Identifiers	% by weight
Ethanol	Ethyl alcohol	64-17-5	60 - 100
Methanol	Methyl alcohol	67-56-1	10 - 30
Ethyl Acetate	Ethyl ethanoate	141-78-6	0.1 - 1.0

Section 4. First-Aid Measures

Eye Contact	Flush eyes with water for 15 minutes. Seek medical attention.
Skin Contact	Flush area with water. If irritation persists seek medical attention. Launder clothing before reuse.
Inhalation	Remove victim to fresh air. If there is difficulty breathing, seek immediate medical attention.
Ingestion	Rinse mouth with water if conscious. Do not induce vomiting. Lay victim on left side to prevent aspiration of any vomit. Seek immediate medical attention.
Most Important Symptoms and Effects Both Acute and Delayed	This product contains Methanol, a toxic substance that can lead to blindness, as well as death.



Safety Data Sheet

Immediate Medical Attention and Special Treatment	Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.
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Section 5. Fire-Fighting Measures	
Suitable and Unsuitable Extinguishing Media	Dry chemical, alcohol resistant foam, carbon dioxide
Hazardous Combustion Products	Carbon monoxide and dioxide
Specific Hazards Arising From the Product	Flammable in the presence of a source of ignition when the temperature is above the flash point. Keep away from heat/sparks/open flame/hot surface. No smoking.
Special Protective Equipment and Precautions For Fire-Fighters	Fire-fighters should wear self-contained breathing apparatus and full protective clothing. Use water spray to cool containers and structures exposed to fire. Vapours from this product may travel or be moved by air currents, these can be ignited by sparks, flames, heaters, static discharge etc.

Section 6. Accidental Release Measures	
Personal Precautions, Protective Equipment and Emergency Procedures	Gloves (nitrile), coveralls (Nomex), safety glasses. Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.
Environmental Precautions	Do not allow product to enter surface drains and watercourses
Methods and Materials For Containment and Clean-Up	Isolate area, restrict access, remove all sources of ignition. Small spills can be soaked up on absorbent material, removed and packed in appropriate containers for disposal. Large spills should be diked and pumped into suitable containers, residues can be absorbed, then the area washed with water.

Section 7. Handling and Storage	
Precautions For Safe Handling	Avoid contact with eyes, skin and clothing. Ground all containers when in use. Keep containers closed when not in use. Keep away from all sources of ignition and open flames. Do not cut or weld empty containers as residues are highly flammable.



Safety Data Sheet

Conditions For Safe Storage	Store in a cool dry place away from all sources of ignition. Empty containers may have flammable residues present. Keep container closed when not in use. Ground containers when in use.
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Section 8. Exposure Controls / Personal Protection				
Control Parameters	TWA: 8 Hr	STEL: 15 min	Ceiling	IDLH *
Ethanol	1000 ppm OSHA	1000 ppm ACGIH		3300 ppm
Methanol	200 ppm (skin) ACGIH	250 ppm (skin) ACGIH		6000 ppm
Ethyl Acetate	400 ppm ACGIH			2000 ppm
* Immediately Dangerous to Life and Health				
Exposure Controls	Local exhaust ventilation			
Appropriate Engineering Controls	Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.			
Individual Protective Measures				
Eye/Face Protection	Wear goggles			
Skin Protection	Neoprene gloves and coveralls – should be cotton or non static generating fabric			
Respiratory Protection	Up to 1000 ppm, an approved air purifying respirator fitted with the organic vapour cartridges should be worn. Above this concentration air supply respirator is recommended			

Section 9. Physical and Chemical Properties	
Appearance	Clear, colourless liquid
Odour	Sweet Alcohol
Odour Threshold	Not available.
pH	Not applicable.
Flash Point	12.5 °C
Boiling Point and Boiling Range	75.6 °C
Melting Point and Freezing Point	No data
Evaporation Rate	Not determined



Safety Data Sheet

Flammability (solid, gas)	Not applicable
Upper and Lower Flammability or Explosive Limits	3.3 %(v) and 19 %(v)
Vapour Pressure	Not determined
Vapour Density	Not determined
Relative Density	0.7889
Solubility	Completely soluble
Partition co-efficient, n-Octanol/Water	log Pow: -0.349 at 24 °C (75 °F)
Auto-ignition Temperature	385 – 427 °C
Decomposition Temperature	No data
Viscosity	No data

Section 10. Stability and Reactivity	
Reactivity	Vapours may form explosive mixture with air.
Chemical Stability	Stable
Possibility of Hazardous Reactions	Will not occur
Conditions to Avoid	Avoid excessive heat, open flames and all sources of ignition.
Incompatible Materials	Oxidizing agents.
Hazardous Decomposition Products	Carbon monoxide, carbon dioxide and formaldehyde.

Section 11. Toxicological Information			
Component Toxicity	LD50 Oral	LD50 Dermal	LC50 Inhalation
Ethanol	7.06 g/kg (Rat)		
Methanol	5.628 g/kg (Rat)	15.8 g/kg (Rabbit)	64000ppm, 4h (Rat)
Ethyl Acetate	5.62 g/kg (Rat)	18g/kg (Rabbit)	
Likely Routes of Exposure			
Skin:	May be absorbed through the skin and cause effects similar to those due to ingestion. May cause dermatitis and skin sensitisation.		
Eyes:	May cause severe eye irritation, with pain and swelling of the conjunctiva.		
Inhalation:			



Safety Data Sheet

Ingestion:	Will cause irritation of the respiratory system. May cause headaches and dizziness, and other central nervous system effects. May cause headache, nausea, abdominal discomfort, vomiting, diarrhea, dizziness, drowsiness, faintness, lack of co-ordination and unconsciousness. The small amount of methanol present may cause similar symptoms, with much more severe reactions, including possible blindness and death if left untreated.
Acute Toxicity Estimate (ATE)	LD50 Oral - Rat - 10,470 mg/kg
STOT (Specific Target Organ Toxicity) – Single Exposure	No data
Aspiration Toxicity	No data
STOT (Specific Target Organ Toxicity) – Repeated Exposure	No data
Skin Corrosion / Irritation	Rabbit - No skin irritation - 24 h - OECD Test Guideline 404
Serious Eye Damage / Irritation	Rabbit - Moderate eye irritation - OECD Test Guideline 405
Respiratory or Skin Sensitization	No data
Carcinogenicity	Ethanol – IARC – Group 1, ACGIH A3
Reproductive Toxicity	
- Sexual Function and Fertility	
- Development of Offspring	Methanol – in experimental animals, methanol is fetotoxic, teratogenic and has produced significant behavioral abnormalities in offspring at doses not producing maternal toxic effects. Ethanol – may cause birth defects or other adverse effects on pregnancy. Effects depend on duration and level of exposure.
- Effects on or via Lactation	No data
Germ Cell Mutagenicity	No data
Interactive Effects	No data
Other Information	Not applicable

Section 12. Ecological Information	
Ecotoxicity	Ethanol: LC50: 12900 mg/l (Oncorhynchus mykiss) LC50: 14.2 mg/l (Pimephales promelas)



Safety Data Sheet

	Methanol: LC50: 13 mg/l (Oncorhynchus mykiss) LC50: 29400 mg/l (Pimephales promelas) Ethyl acetate: LC50: 484 mg/l (Oncorhynchus mykiss) LC50: 230 mg/l (Pimephales promelas)
Persistence and Degradability	Result: 95 % - Readily biodegradable
Bioaccumulative Potential	No data
Biodegradability	Expected to be completely biodegradable
Mobility in Soil	No data
Other Adverse Effects	Not applicable

Section 13. Disposal Considerations

Disposal Considerations	Dispose of contents / container in accordance with local regulations
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Section 14. Transport Information

UN Number	1986
UN Proper Shipping Name	Alcohols, Flammable, Toxic, N.O.S. (Methanol)
Transport Hazard Class(es)	3 (6.1)
Packaging Group	II
Environmental Hazards	Not applicable
Bulk Transport	Not applicable
Special Precaution	Not applicable
DOT Erg#	131

Section 15. Regulatory Information

Canada – DSL Inventory	All components of this product are either on the Domestic Substances List (DSL) or Non-Domestic Substances List (NDSL) or exempt
TSCA	All components of this product are either on the Toxic Substances Control Act (TSCA) Inventory List or exempt
Additional Information	None



Safety Data Sheet

Section 16. Other Information	
NFPA Rating	Health-2/ Flammability-3/Reactivity-0/Special Hazard-Not applicable
HMIS Rating	Health-2/Flammability-3/Reactivity-0/Personal Protection-See Section 8.
Prepared by:	Chemfax Products Ltd., Technical Department
Date Prepared:	September 23, 2011
Date of Latest Revision:	25 January 2021
Disclaimer	
Notice to reader	
<p>To the best of our knowledge, the information contained herein is accurate. However, neither the above named supplier nor any of its subsidiaries assumes any liability whatsoever for the accuracy or completeness of the information contained herein. Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.</p>	
<p>Chemfax Products Ltd. expressly disclaims all expressed or implied warranties of merchantability and fitness for a particular purpose with respect to the product provided.</p>	

UHU Plus Endfest 300³³

UHU Technical Data Sheet

UHU plus endfest 300

UHU plus endfest 300 is a solvent-free two-component adhesive based on epoxy resin that allows extremely firm assemblies using a wide range of materials. UHU plus endfest 300 has a UL admission.

Specification of UHU plus endfest 300	
Chemical basis	epoxy resin
Adhesive technique	wet adhesion
Temperature range for use	between -40 and +100°C (dependent on material and construction; higher temperatures may also be possible - see chart page 3)
Consistency	binder: High viscosity hardener: medium viscosity
Viscosity [mPa.sec]	binder: 40000 hardener: 30000
Basis	binder: epoxy resin hardener: aliphatic amines
Solvent	none
Solid body content [%]	100
Density [gm/cm ³]	binder: approx. 1.2 hardener: approx. 0.96
Flame point [°C]	binder: approx. 210 hardener: approx. 110
Danger category under German legislation	none
Indication(s) according to legislation on dangerous substances	binder: irritant; contains epoxy resin hardener: irritant; contains amines
Danger symbol(s)	Xi; N
Working life (at 20°C)	90 mins.
Mechanical strength values:	Mixing ratio (by volume) 1:1; testing at room temperature
Firm to the touch:	6 hours
Firm enough to use:	12 hours
Final firmness:	24 hours
Combined tension and shear resistance (aluminium)	Mixing ratio (by volume) 1:1; testing at room temperature
	10 hours: 500N/cm ² 24 hours: 1200N/cm ² 5 days: 1700N/cm ² 1 month: 1700N/cm ²
Mixing ratio (by volume)	1:1 (other mixing ratios possible)
Optimum temperature for use	between +18 and +20°C
Resistance	many solvents, dilute acids and alkalis
Unsuitable materials	polyethylene, polypropylene, Teflon®, polystyrene, soft PVC and various other materials
Colour	binder: opaque hardener: honey coloured

UHU GmbH & Co. KG · P.O. Box 1552, D-77813 Bühl, Tel. +(49) 7223 284-0 · Fax +(49) 7223 284-465 Internet: www.uhu.de

³³ UHU GmbH & Co. KG. *Technical Data Sheet: UHU Plus Endfest 300, St-D5346*. Accessed August 1, 2025. <https://www.uhubostik.it/images/uploads/uhu/st-D5346.pdf>.

UHU Technical Data Sheet

UHU plus endfest 300

Properties:

After the two components have been mixed, UHU plus hardens with almost no loss of volume to form a duroplastic synthetic resin. The parts to be assembled usually need to be fixed under pressure. It is not necessary to apply extreme pressure. Hardening takes place by evaporation. The working consistency is so designed that a good bond is achieved at room temperature with a minimal amount of movement.

The UHU plus system enables the user to achieve a harder or softer final product by varying the quantity of hardener used:

a) The mixing ratio 100 parts binder by weight
+ 50 parts hardener by weight
produces a harder end product with slightly greater resistance to heat, water and chemical substances.

b) The mixing ratio 100 parts binder by weight
+ 80 parts hardener by weight
(equal lengths of strips from the tubes) is the normal mixing ratio for universal applications.

c) The mixing ratio 100 parts binder by weight
+ 120 parts hardener by weight
produces an end product that is flexible and resists peeling better, although it is less resistant to heat, water and chemical substances.

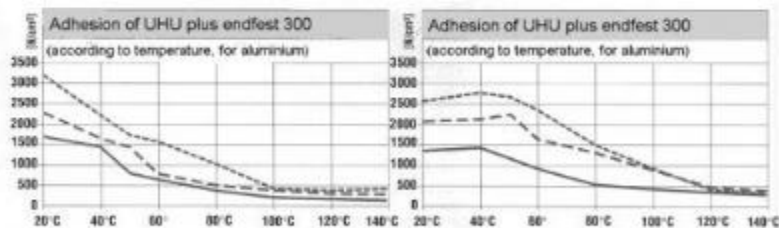
Within these limits, any mixing ratio is possible depending on requirements. A higher proportion of hardener reduces the working life of the mixture and its hardness.

Temperatures below 18°C slow down the hardening process and result in poor adhesion; extra warmth (heater, infrared radiator or similar) is therefore needed when working in cold places or in the open air.

Particularly strong adhesion is achieved if hardening takes place at a higher temperature, in the region of 70 to 180°C. The following table shows the relationship between time and temperature for minimum hardening times:

45 minutes at 70 °C
30 minutes at 80 °C
20 minutes at 90 °C
10 minutes at 100 °C
7 minutes at 120 °C
6 minutes at 140 °C
5 minutes at 150 - 180 °C

Temperatures should not exceed 200°C either during hardening or when the assembly is subsequently put under pressure, as this would affect firmness and the stability of the substance.



Mixing ratio
(binder and hardener,
by volume) 1:1
= mixing ratio (by weight)
100:80

Hardening at room
temperature
Hardening: 20 mins. at 100°C
Hardening: 5 mins. at 180°C

Mixing ratio (by weight)
100:50

Hardening at room
temperature
Hardening: 20 mins. at 100°C
Hardening: 5 mins. at 180°C



Technical Data Sheet

UHU plus endfest 300

Testing: In accordance with DIN 53286; testing fixed at pressure of 1 bar; seven days' storage at 20°C/65% relative humidity prior to testing; Zwick testing machine with temperature chamber (testing speed: 50mm/min.).

Test conditions: Application surface: 25 x 10mm = 250 mm²
Test piece: AlCuMg 1, sandblasted (Korund ELK 90):
82,5 x 25 x 1,5mm

Adhesion of UHU plus endfest 300 according to temperature		
Temperature	Hardening time	Bond strength*
20°C	12 hrs.	approx. 1200 N/cm ²
40°C	3 hrs.	approx. 1800 N/cm ²
70°C	45 mins.	approx. 2000 N/cm ²
100°C	10 mins.	approx. 2500 N/cm ²
180°C	5 mins.	approx. 3000 N/cm ²

* at combined tension and shear strain for aluminium

When sticking together materials with different coefficients of the thermal expansion, care must be taken that the adhesive makes only a small difference in length if the temperature varies. In such cases it is therefore recommended that the proportion of hardener in the mix should be increased, rendering the end product more flexible. (cf. page 1)

Relatively large metal parts, such as signs, are extremely difficult to remove subsequently from glass surfaces as resin solvent can only reach the adhesive near the edges.

UHU plus endfest 300 should therefore not be used for sticking signs, letters and similar items to large glass surfaces such as shop windows, since the bond is so strong that dimensional changes in the metal could result in the glass breaking under unfavourable conditions.

Resistance:

UHU plus joins are resistant to moisture, oil, dilute acids and alkalis and many solvents. Moisture, dilute acids and alkalis have very little effect on bond strength, even in the event of lengthy exposure. No universally valid data can be given as there are always many factors, such as the possibility of corrosion, duration of exposure and temperature, that affect the assembly.

Some solvents, such as methylene chloride and trichloroethylene (Warning! Precautions must always be taken when using these substances!), soften the adhesive over a period of time. This effect can be made use of for dissolving adhesive joints.

UHU plus is resistant to ageing and weathering. The adhesive is not affected by even extremely low temperatures.

At temperatures below -60°C, resistance to combined tension and shearing is reduced to approximately 75-80% of the value measured at room temperature; if the samples are heated up to room temperature once more, the original bond strength is also regained.

Physical Properties:

Hardened UHU plus has exceptional electrical insulation properties:

Specific resistance: 5.6 - 5.8; 10²³ Ω.cm at 100 V and 21 °C.

Heat Conductivity according to DIN 52612 is 0.249 W/m·K at 28.3 °C.

The linear coefficient of thermal expansion is 90.10⁻⁶ K⁻¹ at 20°C.

Compression resistance (according to DIN 53454 measured using cubes measuring 10 mm)

100 : 50 parts weight approx.	69 N/mm ²
100 : 80 parts weight approx.	45 N/mm ²
100 : 100 parts weight approx.	16 N/mm ²

UHU Technical Data Sheet

UHU plus endfest 300

Application:

Preliminary treatment of surfaces to be stuck together.

The surfaces to be stuck together must be cleaned very thoroughly before the adhesive is applied. It is worth first using abrasive cloth (abrasive rating 100), then degreasing using cellulose moistened with a grease solvent such as acetone. Special preliminary treatments to achieve the best possible bond strengths are described in DIN Regulation 53281 (Sheet 1). (This may be obtained from Beuth-Verlag GmbH in Berlin.)

Aluminium and its alloys should be pre-treated using the "pickling" process. The cleaned parts are dipped in a caustic solution at 60 - 65 °C for 30 minutes.

This solution has the following composition:

- 27.5 parts by weight of concentrated sulphuric acid (density: 1.82 g/cm³)
- 7.5 parts by weight of dichromate of sodium (Na₂Cr₂O₇ · 2H₂O)
- 65.0 parts by weight of water

After pickling, the parts should be rinsed thoroughly and left to dry in a warm air current. For other metals, see DIN 53281, Sheet 1.

Rubber: Surfaces made of vulcanised natural or synthetic rubber should be treated with concentrated sulphuric acid (density 1.82 g/cm³) for between 2 and 10 minutes, depending on the quality of the rubber. The parts should then be very thoroughly rinsed to remove all trace of acid, and dried. If hairline cracks are visible on the treated surface when the part is flexed, this indicates that the surface has been sufficiently pre-treated.

Glass, porcelain and similar materials normally only need to be degreased using solvent. For wood, care must be taken to ensure that the surface is free of dust.

Hardened plastics (duroplasts) such as phenolic resin (Bakelite), melamine, urea, resorcin, polyester and epoxy resins should be roughened with an abrasive cloth (abrasive rating 100) and degreased as above.

UHU plus is not suitable for use with **thermoplastic plastics** such as polyethylene, polypropylene, polystyrene and soft PVC.

Dosing and mixing:

Precise dosing and thorough mixing are essential for good bonding and even joints.

The normal mixing ratio is **1:1 by volume** (equal lengths of strands from the tube), which is equivalent to 100 parts binder by weight + 80 parts hardener by weight.

Small variations in the proportions of binder and hardener make virtually no difference.

For mixing it is best to use a plastic cup (in polyethylene, for example) or an unwaxed paper cup. Alternatively, small quantities may be mixed on a glass plate or something similar, using a wooden or metal spatula. Mixing should continue until the paste is of an even colour and the components are thoroughly combined.

As soon as possible after mixing, the paste should be applied to the surfaces to be stuck together in order to achieve the best possible bond. The adhesive is applied using a wooden or metal spatula, or a short-haired brush. For large areas, a fine-toothed spatula should be used as this ensures an even application. For use in mass production, we will be pleased to point out manufactures of dosing, mixing and processing machinery.

Application time (period of usability):

At room temperature approximately 1 to 1 1/2 hours.

Cleaning:

Apparatus should be cleaned before the adhesive has hardened – acetone and nitro thinners are suitable solvents for this. The same applies to soiled clothing.

UHU GmbH & Co. KG - P.O. Box 1552, D-77813 Bühl, Tel. +(49) 7223 284-0 - Fax +(49) 7223 284-465 Internet: www.uhu.de

UHU Technical Data Sheet

UHU plus endfest 300

Protective precautions:

When using UHU plus endfest 300, contact of the adhesive with the skin should be avoided as much as possible. Cleanliness makes the work easier. The hands should be cleaned using soap and water – never solvent – as soon as possible. For mass production, the workplace must be well ventilated. Once hardened, UHU plus is, like most synthetic materials, physiologically safe and has no smell or taste. It is not recommended that this product is used to stick together parts that are likely to come into contact with foodstuffs, as it has not been authorised for this by appropriate American or German authorities.

Package sizes:

Tube of binder, tube of hardener, 15g, 33g, 163g
Tin of binder, 915g/tin of hardener, 740g
Double-barrelled cartridge, 50ml/54.4g
Tub of binder, 5kg/tub of hardener 4kg

Note:

This information is the result of carefully executed tests. This Technical Data Sheet has been prepared to the best of our knowledge to provide you with advice when gluing. We cannot be held responsible for the results or any damage suffered, as the variety of factors involved (type and combination of materials and working method) are beyond our control. Users have to carry out their own checks and trials. Liability can only be accepted for the consistently high quality of our product.

Epo Putty (Alteco)³⁴

Page 1 of 4



MATERIAL SAFETY DATA SHEET

2Ton Quick Epoxy/3Ton Quick Epoxy RESIN

Date: 11 September 2017

Rev No.: 0

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY

Product Name: 2Ton Quick Epoxy/3Ton Quick Epoxy Resin

Company: Alteco Chemical Pte Ltd
19 Tuas Avenue 11
Singapore 639084

Telephone: +6568620377
Fax: +6568620221

2. HAZARDS IDENTIFICATION

GHS Classification:

Acute toxicity	Class 5
Skin irritation	Class 2
Aquatic Chronic	Class 2
Skin sensitizer	Class 1

GHS Label Element:
Pictogram



Signal Word: Warning

Hazard Statement(s):
May be harmful if swallowed.
Cause skin irritation.
May cause an allergic skin reaction.
Cause serious eye irritation.
Toxic to aquatic life with long lasting effects.

Precautionary Statement(s):
Wear protective gloves.
If swallowed, rinse mouth.
If on skin, wash with soap and water.
If in eye, rinse with water. Remove contact lenses.
If exposed or concerned, get medical treatment.
Dispose of contents and container, send to licensed operator.

Hazard symbol(s): Irritant

3. COMPOSITION / INFORMATION OF INGREDIENTS

Component	CAS No.	Percentage
Bisphenol A Epoxy resin	25068-38-6	45-55%
Talc	14807-96-6	45-55%

4. FIRST-AID MEASURES

After Inhalation: If inhaled, remove to fresh air. If not breathing give



³⁴ Alteco Chemical Pte Ltd. *Product Data Sheet: A+B Epo Putty, Two-Part Epoxy Adhesive*. Accessed on August 1, 2025. <https://gedislub.com/wp-content/uploads/ALTECO-AB-PDS.pdf>.

	artificial respiration. Consult a physician.
After Skin Contact:	In case of contact, immediately wash skin with soap and copious amounts of water. Consult a physician.
After Eye Contact:	In case of contact, immediately flush eyes with copious amounts of water for at least 15 minutes and consult a physician.
After Ingestion:	Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

5. FIRE-FIGHTING MEASURES

Extinguisher Media:	Suitable: Carbon dioxide, dry chemical powder, or appropriate foam.
Special Protecting Equipment or Firefighter:	Wear self contained breathing apparatus and protective clothing to prevent contact with skin and eyes.

6. ACCIDENTAL RELEASE MEASURES

Procedure(s) of Personal Precaution(s):	Wear respirator, chemical safety goggles, rubber boots, and heavy rubber gloves.
Environmental Precautions:	Do not let product enter drain.
Methods for Cleaning up:	Sweep up, place in a bag and hold for waste disposal. Avoid raising dust. Ventilate area and wash spill site after material pickup is complete.

7. HANDLING AND STORAGE

Precautions Handling:	Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Provide appropriate exhaust ventilation at places where dust is formed. Normal measure for preventive fire protection.
Condition for Safe Storage:	Store in cool place. Keep container tightly closed in a dry and well-ventilated place.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Control:	Safety shower and eye bath. Mechanical exhaust required.
General Hygiene Measures:	Wash thoroughly after handling.
Personal Protecting Equipment:	Respiratory Protection: Government approved respirator. Hand Protection: Compatible chemical resistant gloves.



Eye Protection: Chemical safety goggles.

[9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Black paste
Property:	Value:
pH:	N/A
BP/BP Range:	N/A
MP/MP Range:	N/A
Flash Point:	N/A
Flammability:	N/A
Autoignition Temp:	N/A
Oxidizing Properties:	N/A
Explosive Properties:	N/A
Explosion Limits:	N/A
Vapor Pressure:	N/A
Water Solubility:	N/A

[10. STABILITY AND REACTIVITY

Stability and Reactivity:	Stable under normal storage condition.
Condition to avoid	Avoid contact with heat and ignition sources
Materials to avoid	Strong oxidizing agent, acids, bases
Hazardous decomposition products	Carbon dioxide. Carbon monoxide.

11. TOXICOLOGICAL INFORMATION

Acute toxicity:	May be harmful if swallowed.
Skin corrosion / irritation:	Cause skin irritation.
Serious eye damage / eye irritation:	Cause eye irritation.
Respiratory or skin sensitization:	May cause sensitization by skin contact.
Germ cell mutagenicity:	No data available
Carcinogenic	No data available
Reproductive toxicity:	No data available
Specific target organ toxicity – single exposure:	No data available
Specific target organ toxicity – repeated exposure:	No data available
Aspiration hazard:	No data available
Potential health effects	

Inhalation	Maybe harmful if inhaled. Causes respiratory tract irritation.
Ingestion	Maybe harmful if swallowed.
Skin	Causes skin irritation.
Eyes	Causes eye irritation.

12. ECOLOGICAL INFORMATION

Toxicity	Moderately toxic to aquatic life.
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13. DISPOSAL CONSIDERATIONS

Substance Disposal:	Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. Observe all federal, state, and local environmental regulations.
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14. TRANSPORT INFORMATION

RID/ADR:	No regulated.
IMDG:	No regulated.
IATA:	No regulated.

15. REGULATORY INFORMATION

Not applicable

16. OTHER INFORMATION

DISCLAIMER:	Information provided is based on our up to date knowledge.
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Paraloid B72³⁵

Material Safety Data Sheet

1. PRODUCT AND COMPANY IDENTIFICATION

PARALOID™ B-72 100% Resin

Revision date: 09/26/2003

Supplier

Rohm and Haas Chemicals LLC
 A Subsidiary of The Dow Chemical Company
 100 Independence Mall West
 Philadelphia, PA 19106-2399 United States

For non-emergency information contact: +12155923000

For non-emergency information contact: 215-592-3000

Emergency telephone number

1 800 424 9300

Local emergency telephone number

989-636-4400

2. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS-No.	Concentration
Acrylic polymer(s)	Not Hazardous	99.0 - 100.0 %
Individual residual monomers	Not Required	<= 0.1 %
Toluene	108-88-3	<= 0.8 %

3. HAZARDS IDENTIFICATION

Emergency Overview
Appearance
Form Granular solid

Colour clear

Odour Acrylic odor

³⁵ Conservation Support Systems. "MSDS Paraloid B-72 100%." Yumpu. Accessed September 16, 2025. <https://www.yumpu.com/en/document/read/28741984/msds-paraloid-b-72-100-conservation-support-systems>.

Hazard Summary**CAUTION!**

INHALATION OF DUST CAN CAUSE THE FOLLOWING:
 IRRITATION OF NOSE, THROAT, AND LUNGS
 HEADACHE
 NAUSEA
 MAY CAUSE EYE/SKIN IRRITATION.

Potential Health Effects

Primary Routes of Entry: Inhalation
 Eye contact
 Skin contact

Eyes: Monomer vapors from heated product can cause the following:
 slight irritation

Skin: Prolonged or repeated skin contact can cause the following:
 slight irritation

Inhalation: Inhalation of dust can cause the following:
 irritation of nose, throat, and lungs

Inhalation of monomer vapor from heated product can cause the following:
 May cause nose, throat, and lung irritation.

headache
 nausea

Toluene	ACGIH	Not classifiable as a human carcinogen.
Toluene	US CA65CRT	Developmental toxin.
Toluene	IARC	Classification not possible from current data.
Toluene	IARC	Inadequate data.
Toluene	IARC	Evidence suggests lack of carcinogenicity.

4. FIRST AID MEASURES

Inhalation: Move to fresh air.

Skin contact: Wash with water and soap as a precaution. If skin irritation persists, call a physician.

Eye contact: Flush eyes with water as a precaution. If eye irritation persists, consult a specialist.

Ingestion: Drink 1 or 2 glasses of water. Consult a physician if necessary. Never give anything by mouth to an unconscious person.

5. FIRE-FIGHTING MEASURES

Flash point	not applicable
Ignition temperature	393.0 °C (739.40 °F) estimated
Lower explosion limit	Not Applicable
Upper explosion limit	Not Applicable
Suitable extinguishing media:	Use the following extinguishing media when fighting fires involving this material: carbon dioxide (CO ₂) dry chemical water spray

Specific hazards during fire fighting: Material as sold is combustible; burns vigorously with intense heat.

Special protective equipment for fire-fighters: Wear self-contained breathing apparatus and protective suit.

Further information: Water mist may be used to cool closed containers.

Remain upwind.

Avoid breathing smoke.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions

Appropriate protective equipment must be worn when handling a spill of this material. See SECTION 8, Exposure Controls/Personal Protection, for recommendations.

If exposed to material during clean-up operations, see SECTION 4, First Aid Measures, for actions to follow.

Environmental precautions

CAUTION: Keep spills and cleaning runoff out of municipal sewers and open bodies of water.

Methods for cleaning up

Floor may be slippery; use care to avoid falling.

Eliminate all ignition sources.

Ventilate the area.

Transfer spilled material to suitable containers for recovery or disposal.

7. HANDLING AND STORAGE

Handling

Store in a cool, dry, well ventilated place. Avoid contact with eyes, skin and clothing. Wash thoroughly after handling. Keep container tightly closed. Do not breathe vapours/dust. Static charges can accumulate; use bonding and grounding between transfer equipment and receiving containers and for any other operations capable of generating static electricity.

Storage

Storage conditions: Material can burn; limit indoor storage to approved areas equipped with automatic sprinklers. Ground all metal containers during storage and handling.

Storage temperature: -18.00 - 49.00 °C (-0.40 - 120.20 °F)

Further information:

Monomer vapors can be evolved when material is heated during processing operations. See SECTION 8, for types of ventilation required.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure limit(s)

Exposure limits are listed below, if they exist.

Component	Regulation	Type of listing	Value
Toluene	Rohm and Haas	TWA	50 ppm
	Rohm and Haas	STEL	75 ppm
	Rohm and Haas	Absorbed via skin	
	ACGIH	TWA	50 ppm
	ACGIH	SKIN_DES	
	OSHA/Z2	TWA	200 ppm
	OSHA/Z2	Ceiling	300 ppm
	OSHA/Z2	MAX. CONC	500 ppm
	Z1A	TWA	375 mg/m ³ 100 ppm

PARALOID™ B-72 100% Resin

Z1A STEL 560 mg/m³ 150 ppm

Eye protection: Use safety glasses with side shields (ANSI Z87.1 or approved equivalent). Eye protection worn must be compatible with respiratory protection system employed.

Hand protection: Cotton or canvas gloves.

Respiratory protection: A respiratory protection program meeting OSHA 1910.134 and ANSI Z88.2 requirements or equivalent must be followed whenever workplace conditions warrant a respirator's use. None required under normal operating conditions. When dusty conditions are encountered, wear a properly fitted NIOSH approved (or equivalent) half-mask, air-purifying respirator. Air-purifying respirators should be equipped with NIOSH approved (or equivalent) organic vapor cartridges and N95 filters. If oil mist is present, use R95 or P95 filters.

Protective measures: Facilities storing or utilizing this material should be equipped with an eyewash facility.

Engineering measures: Use local exhaust ventilation with a minimum capture velocity of 150 ft/min. (0.75 m/sec.) at the point of dust or mist evolution. Refer to the current edition of "Industrial Ventilation: A Manual of Recommended Practice" published by the American Conference of Governmental Industrial Hygienists for information on the design, installation, use, and maintenance of exhaust systems.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

Form	Granular solid
Colour	clear
Odour	Acrylic odor
pH	Not Applicable
Boiling point/range	not applicable
Melting point/range	no data available
Flash point	not applicable
Ignition temperature	393 °C (739.40 °F) estimated
Lower explosion limit	Not Applicable
Upper explosion limit	Not Applicable
Vapour pressure	Not Applicable
Relative vapour density	Not Applicable
Water solubility	practically insoluble
Density	0.66 g/cm ³ Bulk density
Viscosity, dynamic	Not Applicable
Evaporation rate	Not Applicable
Percent volatility	1 % maximum

NOTE: The physical data presented above are typical values and should not be construed as a specification.

10. STABILITY AND REACTIVITY

Hazardous reactions	None known. This material is considered stable. However, avoid temperatures above 260C/500F. Thermal decomposition is dependent on time and temperature.
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Materials to avoid	There are no known materials which are incompatible with this product.
Hazardous decomposition products polymerization	Thermal decomposition may yield acrylic monomers., Product will not undergo polymerization.

11. TOXICOLOGICAL INFORMATION

Acute oral toxicity	LD50 rat > 5,000 mg/kg Toxicity data for a compositionally similar material.
Acute dermal toxicity	LD50 rabbit > 3,000 mg/kg Toxicity data for a compositionally similar material.
Skin irritation	rabbit slight irritation Toxicity data for a compositionally similar material.
Eye irritation	rabbit slight irritation Toxicity data for a compositionally similar material.

Further information

No data are available for this material. The information shown is based on profiles of compositionally similar materials.

Component: Toluene

Acute inhalation toxicity LC50 rat 4 h 15.07 mg/l

12. ECOLOGICAL INFORMATION

There is no data available for this product.

Toluene

Ecotoxicity effects

Toxicity to fish	LC50 Rainbow trout 96 h 24 ppm
Toxicity to fish	LC50 Fathead minnow (Pimephales promelas) 96 h 26 ppm
Toxicity to fish	LC50 Bluegill sunfish 96 h 13 ppm
Toxicity to algae	EC50 Algae 96 h >433 ppm
Toxicity to aquatic invertebrates	EC50 Daphnia magna 48 h 11.5 ppm

13. DISPOSAL CONSIDERATIONS

Environmental precautions: CAUTION: Keep spills and cleaning runoff out of municipal sewers and open bodies of water.

Disposal

Waste Classification: When a decision is made to discard this material as supplied, it does not meet RCRA's characteristic definition of ignitability, corrosivity, or reactivity, and is not listed in 40 CFR 261.33. The toxicity characteristic (TC), however, has not been evaluated by the Toxicity Characteristic Leaching Procedure (TCLP).
For disposal, incinerate this material at a facility that complies with local, state, and federal regulations.

14. TRANSPORT INFORMATION

DOT

Not regulated for transport

IMO/IMDG

Not regulated (Not dangerous for transport)

15. REGULATORY INFORMATION

Workplace Classification

This product is considered non-hazardous under the OSHA Hazard Communication Standard (29CFR1910.1200).

This product is a 'controlled product' under the Canadian Workplace Hazardous Materials Information System (WHMIS).

SARA TITLE III: Section 311/312 Categorizations (40CFR370): This product is not a hazardous chemical under 29CFR 1910.1200, and therefore is not covered by Title III of SARA.

SARA TITLE III: Section 313 Information (40CFR372)

This product does not contain a chemical which is listed in Section 313 at or above de minimis concentrations.

CERCLA Information (40CFR302.4)

Releases of this material to air, land, or water are not reportable to the National Response Center under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or to state and local emergency planning committees under the Superfund Amendments and Reauthorization Act (SARA) Title III Section 304.

US. Toxic Substances Control Act (TSCA) All components of this product are in compliance with the inventory listing requirements of the U.S. Toxic Substances Control Act (TSCA) Chemical Substance Inventory.

Pennsylvania

Any material listed as "Not Hazardous" in the CAS REG NO. column of SECTION 2, Composition/Information On Ingredients, of this MSDS is a trade secret under the provisions of the Pennsylvania Worker and Community Right-to-Know Act.

California (Proposition 65)

This product contains a component or components known to the state of California to cause birth defects or other reproductive harm:

Components:	Toluene	108-88-3
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California (Proposition 65)

This product contains trace levels of a component or components known to the state of California to cause cancer and birthdefects or other reproductive harm:

Components:	Benzene	71-43-2
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16. OTHER INFORMATION

Hazard Rating

PARALOID™ B-72 100% Resin

	Health	Fire	Reactivity
HMIS	1	1	0

Legend

ACGIH	American Conference of Governmental Industrial Hygienists
BAC	Butyl acetate
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
STEL	Short Term Exposure Limit (STEL):
TLV	Threshold Limit Value
TWA	Time Weighted Average (TWA):
	Bar denotes a revision from prior MSDS.

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

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