7）カンバス作品（アクリル画）の安定化処理

綿布に描かれたアクリル画の安定化処理は可能か

陸前高田市立博物館の被災カンバス画は、全国美術館会議の主導による応急処置が施され、現在岩手県立美術館で保管されています。東京国立博物館では、カンバス画の抜本修理を見据え、安定化処理（脱塩処理）の実験をおこないました。処理にもっとも有効な媒材は水です。紙を支持体とするものや民俗資料等の多くは水で処理がおこなわれ、一定の成果を得ています。

一方、カンバス画は水分によって支持体である繊物繊維が伸縮し、目止めの膠がゆるむことで絵具層に亀裂や剥落を引き起こす危険性が高いとされます。被災したカンバス画には、絵具層の浮き上がりも多くみられたため、水分を用いた処理は困難視され、これまで積極的な処理は施されませんでした。しかし、残留塩分が作品に与える長期的な影響を考慮する必要があり、比較的損傷が軽度な綿繊維の平織りカンバスに描かれたアクリル画について、水を用いた安定化処理が可能であるか否か実験を試みました。

安定化処理に向けて　サンプルを用いた事前実験

安定化処理の対象作品は、1984年に行木正義が描いた《1984の黒》２枚１組作品。寸法259.5×193.5㎝、木枠に張られた綿布（高知県立紙産業センターによる繊維検査で経・緯糸ともに綿繊維）に描かれたアクリル画です。震災後に応急処置として付着した泥やカビ跡の除去、裏面は消毒用アルコールを含ませた布を用いた洗浄がおこなわれました。海水に浸かったにも関わらず、ステープルの錆、画面のカビ跡、画面の付着物を除けば、木枠や画布に目立った縮み等はみられませんでした。浸水した大型のアクリル画のなかには、被災したとは思えないような保存状態のものがあることに驚きました。そこで、200号の同寸カンバスを含むサンプルを作製し、水に対するカンバスと絵具層の挙動を確認しました。実験は次の通りです。

（1）蛍光Ｘ線分析装置による作品の残留塩素の分析、確認。分析に使用した蛍光Ｘ線分析装置は、日本電子株式会社　蛍光Ｘ線分析装置　DELTA／Soil　モード　Beam3／120秒／測定点あたり5回（平均値を測定値として採用）／非接触、距離：約１mm

（2）サンプルを作製し（図1、2）、一部は浸水（図3）。未浸水品との比較のためそれぞれの塩素濃度を蛍光Ｘ線分析装置で分析、確認（図4）。サンプル仕様：フナオカ・カンバス用綿布（地塗りなし）、市販の木枠（杉材･F4号）、リキテックス・アクリル絵具（マルスブラック、チタニウムホワイト）。比較のためにガッシュも用いて作製。海水と同等の塩分濃度3.7％の海水は、安定した濃度と水質が得られる人工海水（株式会社カイスイマレン/マリンソルト http://www.kaisuimaren.co.jp）を使用。

（3）前項の分析結果から、未浸水品とほぼ同等レベルの塩素濃度に下げるための安定化処理に向けて、サンプルを用いた処理実験（吸取紙使用、サクションテーブル

7) Stabilization of Canvas Paintings (acrylic paintings)

The possibility of stabilizing acrylic paintings drawn on cotton cloth

The disaster-damaged canvas paintings owned by the RTCM were given emergency treatment under the guidance of the Japanese Council of Art Museums, and are currently stored at the IPMM. In preparation for performing a basic treatment on the canvas paintings, the Tokyo National Museum performed stabilization (desalination) experiments. Water is considered the most effective medium for desalination. Many items including those with paper-based support media and folk culture assets have been treated by water, and good results have been obtained from those treatments constantly.

On the other hand, it is generally believed that the layer of paint on a canvas painting is highly likely to crack and/or peel off due to the glue loosening when its support medium, textile fibers, contracts and expands as a result of absorbing water. Since loose paint has been observed in many disaster-damaged canvas paintings, treatment using water has been considered difficult to perform. Thus, no aggressive treatment has been performed so far. However, since the long-term effects of residual salt on the paintings must be taken into consideration, experiments were conducted with acrylic paintings drawn on plain weave cotton fiber canvases with relatively little damage to verify whether it is possible or not to stabilize the assets using water.

In preparation for performing stabilization – preliminary experiments using samples

An experiment was conducted in preparation for stabilization of a work of Masayoshi Nameki's painted in 1984. The artwork was a set of two acrylic paintings titled *Black of 1984* sized 259.5×193.5 cm and drawn on a cotton cloth (a fiber analysis conducted by the Kochi Prefectural Paper Industrial Technology Center confirmed that both the warp and the weft were cotton fiber) mounted on a wooden frame. After salvaging the asset, attached dirt and mold stains were removed, and the back sides were washed using a cloth dampened with an alcohol sanitizer as an emergency treatment. Excluding the mold stains, accretions on the front side, and the rust on the staples, there was no serious shrinking or other damage on the wooden frames or the canvases, despite having been soaked in seawater. It was surprising that the large acrylic paintings soaked in seawater were preserved in such a state in which little damage from the disaster occurred. We made samples, including ones in the same size as that of Nameki's paintings, 259.0 x 194.0 cm, and confirmed the behavior of the canvases and paint layers in relation to water. The experiment procedure is described below.

(1) Analysis and confirmation of residual chlorine in the artwork using an X-ray fluorescence analyzer. The analysis was performed using the X-ray fluorescence analyzer of JEOL Ltd.; DELTA/Soil Mode Beam 3/120 sec./five measurements per measuring point (the average was used as the measurement value) / non-contact, distance: approx. 1 mm.

(2) Samples were prepared (Figs. 1 and 2), and some of them were soaked in artificial seawater (Fig. 3). For comparison with unsoaked samples, the chlorine concentration of each sample was analyzed and confirmed using the X-ray fluorescence analyzer (Fig. 4). Sample spec: cotton cloth for canvas made by FUNAOKA LIMITED (no undercoating), commercial wooden frame (made of cedar / 33.3 x 24.2cm), Liquitex Acrylics (Mars Black and Titanium White). For comparison, some samples were created with gouache. The artificial seawater used in this experiment contained a salinity level equivalent to seawater, 3.7%, an artificial seawater product with stable concentration and water quality (Marine-Salt; Kaisuimaren Co., Ltd.; http://www.kaisuimaren.co.jp) was used.

(3) Treatment experiments, based on the analytical results

図1　カンバス用綿布を木枠に張り込み、アクリル絵具を塗ってサンプルを作る
Fig. 1　Samples were made by mounting cotton cloth on wooden frames and painting with acrylics.

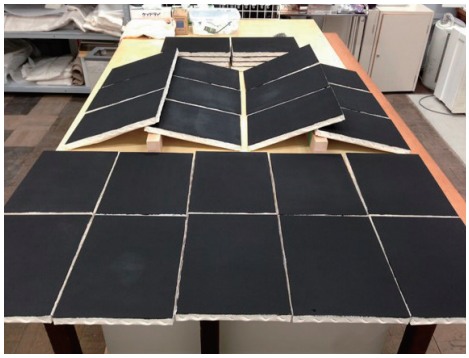


図2　被災作品とほぼ同様の技法でサンプルを製作
Fig. 2　Samples were created using techniques almost identical to those used for restoring the disaster-damaged artwork.

図3　比較のため数分～数時間のパターンで人工海水に浸す
Fig. 3　For comparison, soaking in artificial seawater was performed in different styles for a duration of a few minutes to a few hours.

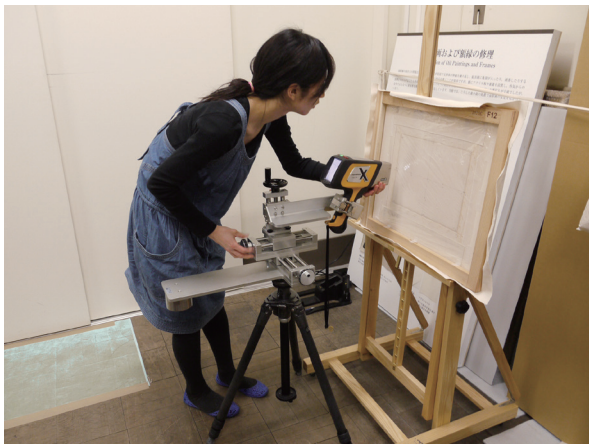


図4　蛍光X線分析装置による塩素濃度の測定
Fig. 4　Salinity measurement using an X-ray fluorescence analyzer

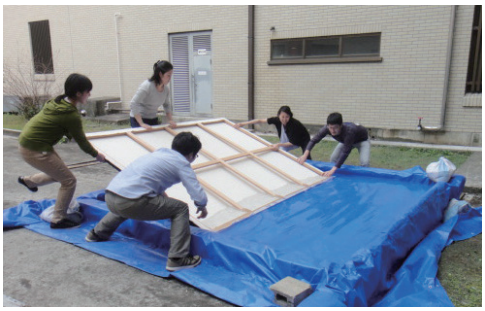
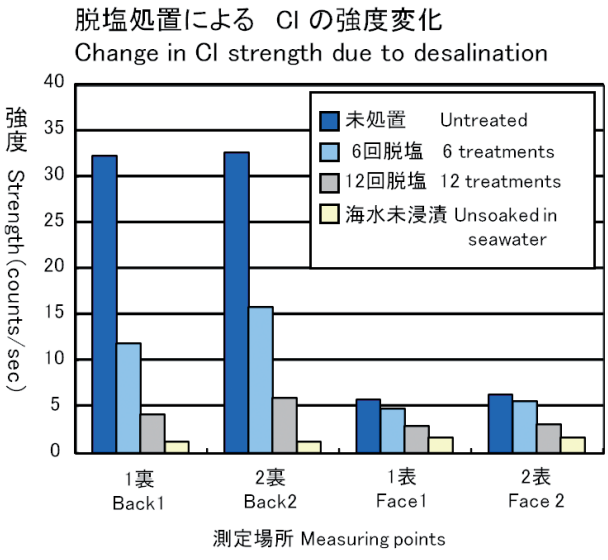


図5　被災作品と同寸のサンプルを人工海水に浸水させる
Fig. 5　Soaking a sample that was the same size as the disaster-damaged artwork in artificial seawater.

図6　浸水後、200号の同寸サンプルに縮みはみられない
Fig. 6　No shrinking was observed in the identical sample after soaking.



※強度は120秒の測定5回分の平均値
Values of strength are the average of five 120-sec. measurements.

図7　吸取紙を用いたサンプルの脱塩処理の効果
Fig. 7　Result of the sample desalination using blotting paper

使用の２パターン）。

（4）作品と同寸サンプル（F200号）の表裏に5㎝角の格子を引き、浸水後にカンバスの縮みの有無を確認（図5、6）。

（5）顕微鏡による絵具層の観察（浸水前後）。

安定化処理の実験結果　水によるアクリル画処置の可能性

実験結果は次の通りでした。

（1）被災作品について、布目が露出した裏面側の方が画面側より塩素濃度が高い。塩素に対する蛍光Ｘ線のカウント数は平均して表は3 ～ 5cps、裏は5 ～ 14cps。

（2）未浸水のサンプルからも平均して2cps程度塩素が検出。浸水サンプルでも表・裏で差があり、平均して表が6cps、裏が33cps程度。なお、浸水時間によりcps値の違いがみられた。

（3）浸水したサンプルを用いて、安定化処理を実施。

一つ目は吸取紙を用いた方法。カンバスの表側を下にして置き、裏から純水を噴霧し、浸透させてから、吸取紙で水分を取る。この作業を繰り返す。６回と12回実施し、その結果、６回ではもとの約半分の15cps前後の値に、12回では5cps程度の値まで減少したが、未浸水の値までは落せなかった（図7）。二つ目はサクションテーブルを用いた方法（図8）。テーブルに吸取紙を敷き、絵画面を下にしてカンバス裏面から純水を噴霧しながらサクションをかけた。アクリル絵具のサンプルにはほとんどサクションが効かない。ガッシュの場合は表面に細かい亀裂等があり、純水の噴霧は２回で、その後は水分がなくなるまで何度も吸取紙を交換しながらサクションを続けた。処置後の塩素濃度は1.5 ～ 2.3cpsと、未浸水のものと同様の値にまで減少。

（4）F200号を浸水した直後・乾燥後ともにサンプルにあらかじめ引いた線等に縮みや変形は認められなかった。

（5）顕微鏡100倍の観察では処置前後で絵具層に亀裂等の異常は認められなかった。

抜本修理に向けての課題　麻布に描かれた油彩画

同寸サンプルの浸水および安定化処理実験から、懸念されたカンバスの縮みや絵具層の変化はほとんど確認されませんでした。このことから「木枠等に張られた状態の綿布に描かれたアクリル画」は水を用いて安定化処理することに耐えうる可能性が高いという結果を得ました。そのほか、今回の実験で次のことがわかりました。

ａ．木枠のないカンバス用綿布を浸水すると数㎝の縮みが認められた（図9）。

ｂ．木枠に張った綿布は浸水しても変形がみられない。

ｃ．布のカンバスは繊維に加工がほどこされており、即座には水がしみこんでいかない（図10）。

ｄ．クリーナーの吸引や消毒用アルコールをしみ込ませた布による拭い程度では塩素濃度に変化がない（図11）。

ｅ．サクションによる安定化処理は樹脂分の少ないガッシュでは有効であったが、アクリル絵具画面は水をほとんど通さないため不適切であった。

described previously and using samples, in preparation for performing stabilization procedures to reduce the salinity of items at nearly the same level as that of unsoaked items (two types: one using blotting paper and the other using a suction table).

(4) Creating approximately 5 cm squares, lines were drawn on the front and the back of a sample of a size identical to Nameki's paintings. Then, post-soaking shrinking of the canvas was checked (Figs. 5 and 6).

(5) Observation of paint layers by a microscope (pre-and post-soaking).

Results of stabilization experiments

Below are the results of the experiments:

(1) In comparison to that of the front side of disaster-damaged paintings, the salinity was higher on the back side where the fabric grain had been exposed. The average fluorescent X-ray count of chlorine was 3 to 5 cps at the front and 5 to 14 cps at the back.

(2) Salinity was also detected in unsoaked samples at an average of approx. 2 cps. There was a difference in salinity levels between the front and the back with soaked samples; the average was approx. 6 cps at the front and 33 cps at the back. Furthermore, there was a difference in the cps values depending on the duration of soaking.

(3) Stabilization was performed using soaked samples.

The first stabilization experiment employed a method that uses blotting paper. The canvas was placed on a flat surface with its front side facing down, and the back side of the canvas was misted with deionized water. After confirming that the water had completely soaked in, moisture was removed from the canvas using blotting paper. This process was repeatedly performed either for 6 times or for 12 times. As a result, salinity was reduced to approx. 15 cps, nearly half the value of the original, after repeating this process for 6 times. The salinity was reduced to approx. 5 cps after repeating the process 12 times. However, the value could not be reduced to the salinity level of the unsoaked samples (Fig. 7). For the second stabilization experiment, a method that used a suction table was employed (Fig. 8). After spreading out blotting paper on the table, the canvas was placed on the table with its front side facing down. Then, suction was applied to the canvas while misting it with deionized water from the back side. Suctioning was not effective on the sample acrylic paintings. As for the samples prepared with gouache, there were many fine cracks and damage on the surface. After being misted with deionized water twice, those samples were suctioned until the moisture was completely removed while exchanging blotting paper sheets several times. The post-treatment salinity reached a level close to that of unsoaked samples at 1.5 to 2.3 cps.

(4) The lines that were drawn on the sample in advance of the soaking, no shrinking or deformation was observed immediately after the sample was soaked and after it had dried.

(5) No abnormality such as cracks was observed in the paint layers either before or after a treatment from observations using a microscope at 100x magnification.

Challenges ahead for performing fundamental treatments

The points of concern, shrinking of the canvas and changes in the paint layers, were rarely observed in these soaking and stabilization experiments using same-size samples. It was found from these results that acrylic paintings drawn on cotton cloth mounted on wooden frames and such are highly likely to endure stabilization treatment using water. In addition, we obtained the following findings from these experiments:

a. A cotton cloth for canvas without a wooden frame shrunk a few centimeters when it was soaked (Fig. 9).

b. Cotton cloths mounted on wooden frames were not deformed

作品に負担を与えずに、より効果的に処置後のcps値を減少させるための今後の課題としては、処置に用いる水の温度、処置の回数、１回の作業面積、浸水時間の検討が挙げられます。対象作品は被災直後の適切な応急修理によって、見た目には安定した状態を保っていました。残留した塩分は劣化を促進するのか、水を使用した安定化処理後、何らかの影響はないのかという二つの疑問がありますが、実際には未知のままであるため、今後さらなる実験と経過観察が必要です。

土屋裕子（東京国立博物館）

even when soaked.

c. Water did not soak into cloth canvases immediately because they were made with treated fibers (Fig. 10).

d. No change in salinity was obtained by simple treatments such as suction by a cleaner or wiping with alcohol sanitizers (Fig. 11).

e. Stabilization by suction was useful for gouache which contains little resin, but not appropriate for acrylic painting surfaces since water does not penetrate them.

The following issues must be evaluated to develop methods for reducing the post-treatment cps values more effectively without damaging the artwork: treatment water temperature, number of treatments, size of areas to work on per one treatment, and soaking duration. The drawings involved in this project appeared to be maintaining stable conditions due to the appropriate emergency treatment being performed on them after the disaster. Since two questions – whether the residual salt will stimulate degradation or not, and whether any post-treatment consequences of stabilization using water will emerge or not – remain unanswered, it is important to continue follow-up observations.

Yuko Tsuchiya (Tokyo National Museum)

図8　サクションテーブルの上で、サンプルに霧吹きで水分与えて脱塩を試みる
Fig. 8　Attempting desalination by providing moisture with an atomizer to the sample on top of the suction table.

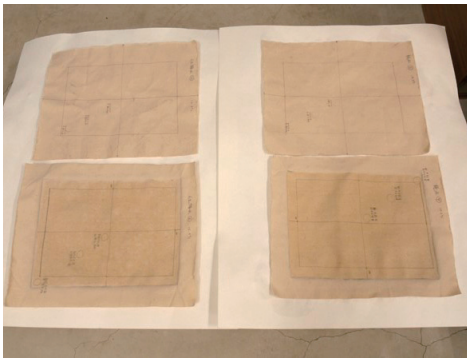


図9　木枠なしの場合、浸水後にカンバス用綿布に縮みがみられた
Fig. 9　A cotton cloth used as canvas with no wooden frame, shrunk after soaking.

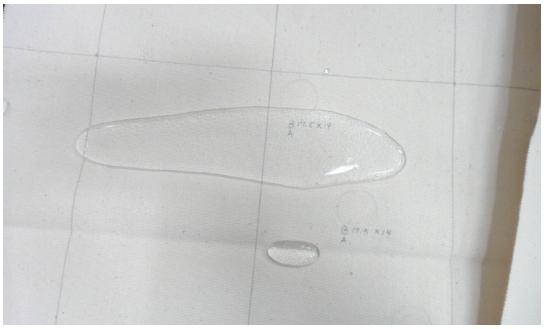


図10　カンバス用綿布には水分はしみこみにくい
Fig. 10　Water does not get absorbed easily by the cotton cloth on the canvas.

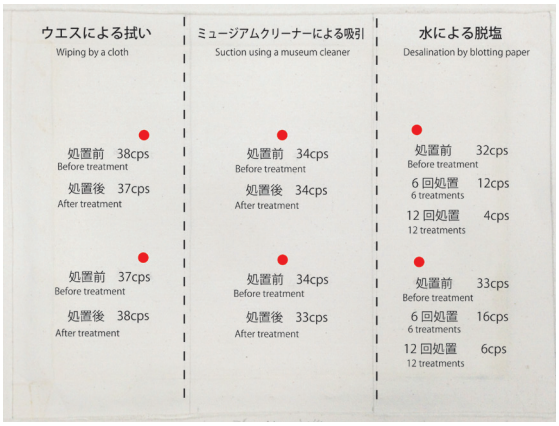


図11　クリーニングの種類によるサンプルの塩素除去の効果
Fig. 11　Results of chlorine removal from samples by cleaning type