# COFFEE FILTER - AL ALLOY - MODERN TIMES - FRANCE

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| **Artefact name** | Coffee filter |
| **Authors** | Christian. Degrigny (HE-Arc CR, Neuchâtel, Neuchâtel, Switzerland) |
| **Url** | /artefacts/1589/ |

## The object

*Credit HE-Arc CR, J.Schröter.*

Fig. 1: Front and back sides of a coffee filter,

## Description and visual observation

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| **Description of the artefact** | Coffee filter with traces of use (deposits, deformation) and presence of local filiform corrosion (Fig. 1). Dimensions: ø.ext. = 10cm. |
| **Type of artefact** | Household implement |
| **Origin** | Château de Germolles, Mellecey, Bourgogne, France |
| **Recovering date** | Unknown |
| **Chronology category** | Modern Times |
| **chronology tpq** | 1960 A.D. |
| **chronology taq** | 2000 A.D. |
| **Chronology comment** | 20th century |
| **Burial conditions / environment** | Outdoor atmosphere |
| **Artefact location** | Château de Germolles, Mellecey, Bourgogne |
| **Owner** | Château de Germolles, Mellecey, Bourgogne |

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| **Inv. number** | None |
| **Recorded conservation data** | N/A |

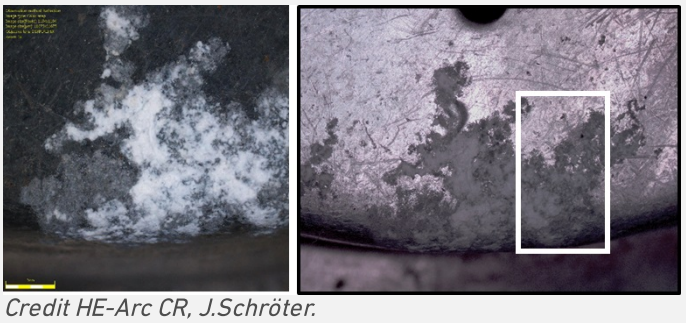
**Complementary information**

None.

## Study area(s)

*Credit HE-Arc CR, J.Schröter.*

Fig. 2: Detail of the front (left) and back (right) sides of the coffee filter showing the location of Fig. 3,



*Credit HE-Arc CR, J.Schröter.*

Fig. 3: Detail of the back side of the coffee filter showing the location of the sampling area (white rectangle),

## Binocular observation and representation of the corrosion structure

None.

## MiCorr stratigraphy(ies) – Bi

## Sample(s)

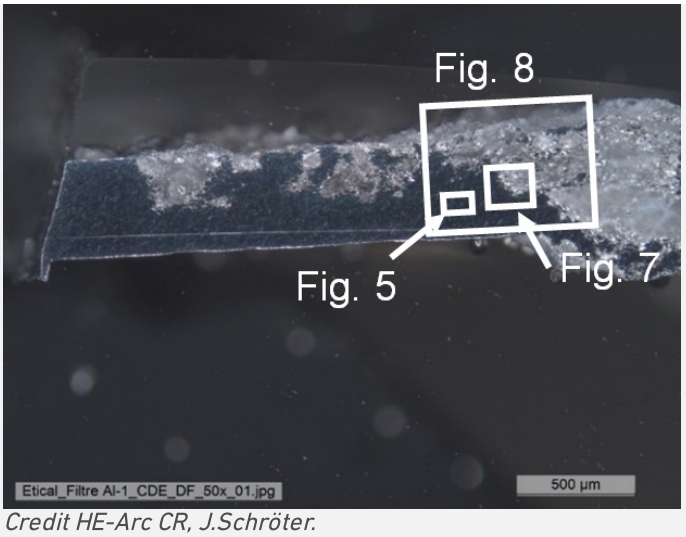



Fig. 4: Micrograph of the cross-section of the fragment sampled from the coffee filter showing the location of Figs. 5, 7 and 8, dark field,

*Credit HE-Arc CR, J.Schröter.*

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| **Description of sample** | Sample cut from the back side of the coffee filter (Fig. 3). |
| **Alloy** | Al Alloy |
| **Technology** | Annealed after (hot) rolling |
| **Lab number of sample** | None |
| **Sample location** | HE-Arc CR, Neuchâtel, Neuchâtel |
| **Responsible institution** | HE-Arc CR, Neuchâtel, Neuchâtel |
| **Date and aim of sampling** | 2017, EtICAL project (Study of corrosion forms of aluminium alloys in Swiss collections) |

**Complementary information**

A second sample was taken and gave similar results.

## Analyses and results

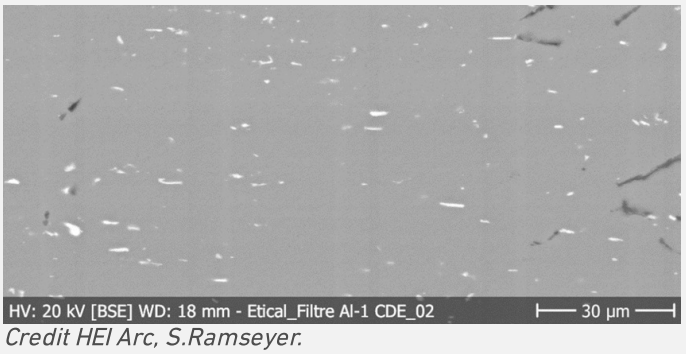
***Analyses performed:***
Metallography, SEM/EDS.

## Non invasive analysis

None.

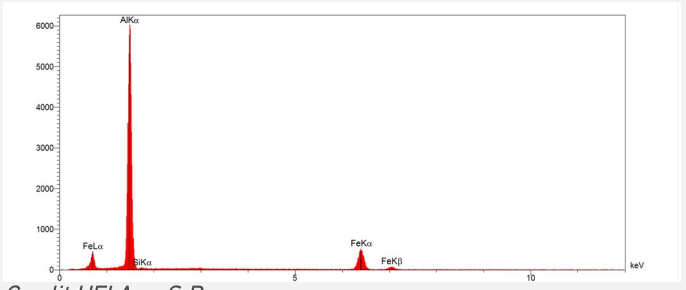
## Metal

The metal is a relatively pure aluminium alloy with numerous elongated inclusions (Fig. 5). From their chemical composition they can be interpreted as Al3Fe intermetallic compounds (Fig. 6). Inter- and transgranular corrosion has developed so extensively that some grains (not elongated) are outlined (Fig. 7).



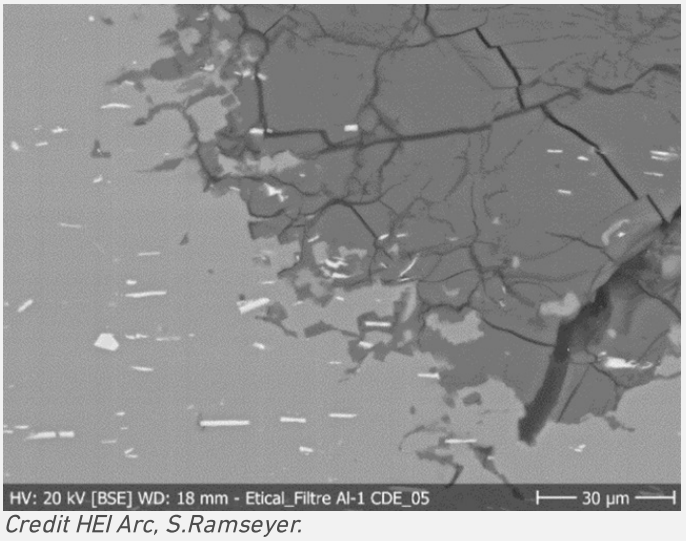
*Credit HEI Arc, S.Ramseyer.*

Fig. 5: SEM image of the metal sample from Fig. 4 (detail), BSE-mode. We observe the presence of numerous elongated inclusions,



*Credit HEI Arc, S.Ramseyer.*

Fig. 6: EDS spectrum of the elongated white inclusions of Fig. 5,



*Credit HEI Arc, S.Ramseyer.*

Fig. 7: SEM image of the metal sample from Fig. 4 (detail), BSE-mode. Extensive inter- and transgranular corrosion has developed within the metal,

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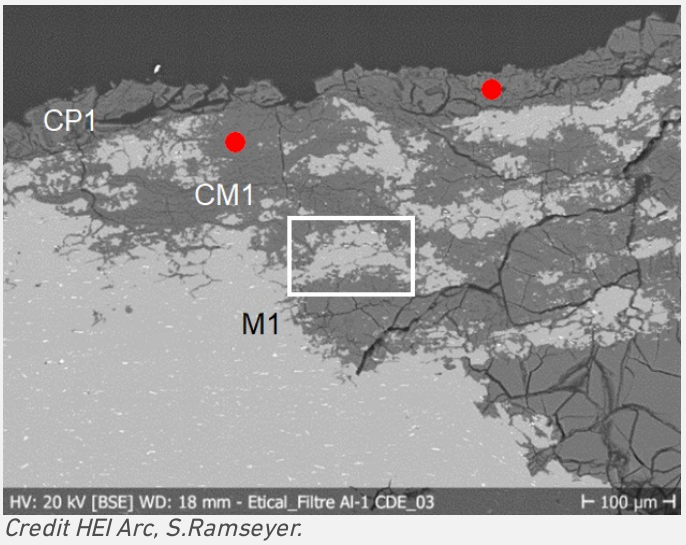
| **Microstructure** | Recrystallized structure (polygonal grains) |
| **First metal element** | Al |
| **Other metal elements** | Fe |

## Complementary information

None.

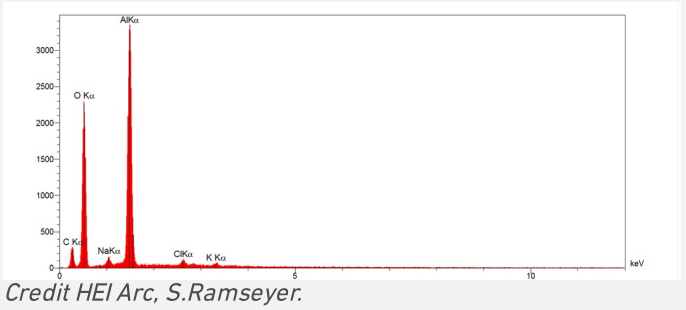
## Corrosion layers

The average thickness of the corrosion layer (CP1) is about 50 micrometers, but may be thinner or thicker depending on the area. Intergranular corrosion developed locally to extend through the entire thickness of the metal. EDS-SEM analysis indicates that the metal is, as expected, covered by a layer rich in Al and O containing chlorides (red spots on Fig. 8) and surprisingly Na (white rectangle on Fig. 8, Figs. 9 and 10). Chlorides do not seem to form active corrosion. A new examination carried out after 4 months (Fig. 11) shows new forms of alteration with a local enrichment of Na, C and O (Na2CO3?).



*Credit HEI Arc, S.Ramseyer.*

Fig. 8: SEM picture (detail of Fig. 4 with location (red spots) of EDS analyses of Fig. 9), BSE-mode. From bottom to top left: the metal (M1) in light grey, the corroded metal (CM1) and CP1. The area selected for elemental chemical distributions (Figs. 10 and 11) is marked by a rectangle,



*Credit HEI Arc, S.Ramseyer.*

Fig. 9: EDS spectrum of red spots in Fig. 8,

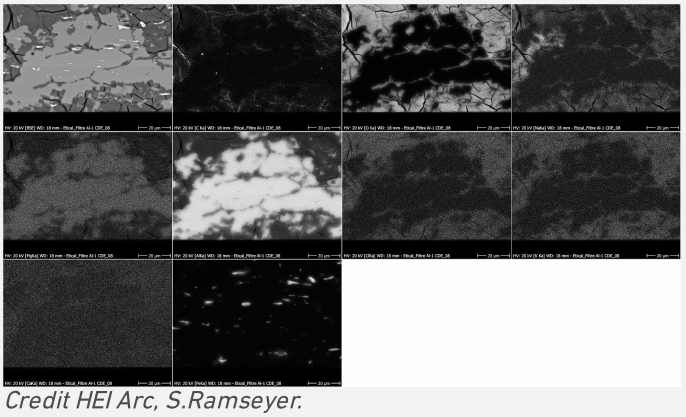

*Credit HEI Arc, S.Ramseyer.*

Fig. 10: SEM image, BSE-mode, and elemental chemical distribution of the selected area of Fig. 8. Method of examination: SEM-EDS, Lab of Electronic Microscopy and Microanalysis, IMA (Néode), HEI Arc,

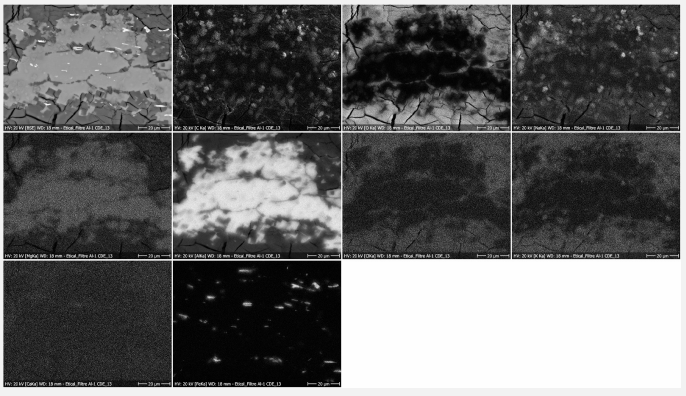


Fig. 11: SEM image,BSE-mode, and elemental chemical distribution of the selected area of Fig. 8 reexaminated after 4 months: new forms of alteration with a local enrichment of Na, C and O are observed,

*Credit HEI Arc, S.Ramseyer.*

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| **Corrosion form** | Multiform - intergranular |
| **Corrosion type** | None |

**Complementary information**

None.

## MiCorr stratigraphy(ies) – CS

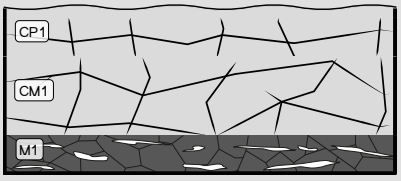


Fig. 12: Stratigraphic representation of the fragment sampled from the coffee filter in cross-section (dark field) using the MiCorr application. The characteristics of the strata are only accessible by clicking on the drawing that redirects you to the search tool by stratigraphy representation. This representation can be compared to Fig. 8, Credit HE-Arc CR, C.Degrigny.

## Synthesis of the binocular / cross-section examination of the corrosion structure

None.

## Conclusion

This aluminium alloy has a composition similar to a primary aluminium with an Al content between 99 and 99.8 mass%. The main impurity is Fe forming intermetallic (Al3Fe) inclusions. The metal was stamped and punctured. It is locally covered by a relatively thick layer of corrosion (probably aluminium oxide) which has formed as a result of surface filiform corrosion which has degenerated into extensive intergranular corrosion. Chlorides have been identified but the progress of the corrosion might be due to Na, C and O-rich compounds (Na2CO3?).

## References

**References on object and sample**

*References object*

1. Degrigny, C. (2018) Etude, identification des objets en aluminium patrimoniaux et classification de leurs formes de corrosion - projet EtICAL, rapport interne HE-Arc CR.
2. Degrigny, C. and Schröter, J. (2019) Aluminium alloys in Swiss public collections: identification and development of diagnostic tools to assess their condition, in Metal 2019, proceedings of the ICOM-CC Metal WG interim meeting, eds. C. Chemello, L. Brambilla, E. Joseph, Neuchâtel (Switzerland), 408-415.

*References sample*

3. Degrigny, C. (2018) Etude, identification des objets en aluminium patrimoniaux et classification de leurs formes de corrosion - projet EtICAL, rapport interne HE-Arc CR.