

# **PVCare: Advances in understanding of acidic gas** emissions from poly(vinyl chloride)

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# Background

Poly(vinyl chloride) (PVC) is not only one of the most commonly used polymers in everyday life, but also an important part of 20<sup>th</sup> and 21<sup>st</sup> century history. However, its degradation poses significant challenges to curators and conservators, particularly due to harmful acidic emissions. One of the known products is HCI, whose formation at temperatures above 150°C is well researched. On contrary, its formation and effect at museum conditions remains unclear. Other possible acidic emissions are not yet well researched, but could pose a potential risk, not only to museum objects, but also to the people who work with them.

# **Methodology and Materials**



#### Emission experiments using microchambers, followed by extraction from sorbent tubes and ion chromatography

Aim: To study surface emissions from PVC, determine their identity and quantity.

**Testing PVC Samples:** 

Newer (2019): PVC1 (unplastized) and PVC2 (plasticized) Older (>30 years): P423, P430 A (unplasticized) and P415 (plasticized)

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### **Results and Discussion**

# Variation of the Oddy test

- All PVC samples caused a negative effect to the reference cellulose.
- Emissions from unplasticized PVC have a greater negative impact on cellulose than those from plasticized PVC.
- Emissions from older PVC are more harmful to cellulose than those from new PVC.

# **Emission experiments**

- The process of HCI emission can be described in two phases:
  - 1. High initial emission rates (ER), with fast decrease to a minimum as a result of HCI residues released from the manufacturing process or previous degradation,
  - Increase to a stable ER HCI is actively formed and emitted from the PVC 2. during the experiment







- With the stable ER from the second phase of experiments at different T, we can predict the HCI emissions at lower temperatures using the Arrhenius equation:
- $\geq$  500 years of sampling at 25°C:  $ER = 0.02 \,\mu g/m^2 year$

- HCI is not the only acidic emission of tested PVC samples they also emit formic and acetic acid. The ER values of the latter are even higher than those of HCI.
- There is a strong correlation between the amount of emitted acetic acid and the



DP/DP0 values obtained at the modified Oddy test – the greater the damage to the reference cellulose, the more acetic acid the sample emitted. Therefore, it can be concluded that acetic acid is one of the most important acidic emissions.

#### **Conclusions:**

The HCI emissions from PVC have been quantified and calculations show that they are less of a problem at room conditions than originally assumed. Formic and acetic acid were also identified as significant emissions, which can significantly contribute to the pollution of the indoor air.

#### References

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