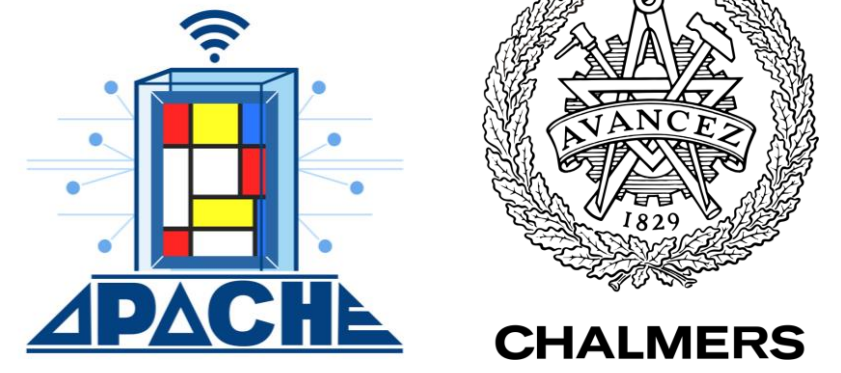


# Functionalized silica adsorbents for pollution capture in museum storage

Part of the **APACHE EU Project**: Active & intelligent **PA**ckaging materials and display cases as a tool for preventive conservation of **Cultural HE**ritage



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## Current issue:

Airborne pollutants in museum storage environments pose a major threat to the longevity of collection objects. Adsorbents can be used to reduce pollutants, but there is a lack of affordable products designed specifically for cultural heritage.

### Airborne pollutants known to deteriorate museum objects

Acetic acid	Formaldehyde	Hydrogen sulfide
Formic acid	Sulfur dioxide	Ozone
Acetaldehyde	Nitrogen dioxide	

## Objectives:

### Current step


Preventive Preservation

**Develop** an adsorbent tailored to capture pollutants known to deteriorate museum objects

**Analyze** adsorbent effectiveness in laboratory and field tests – determine optimal material

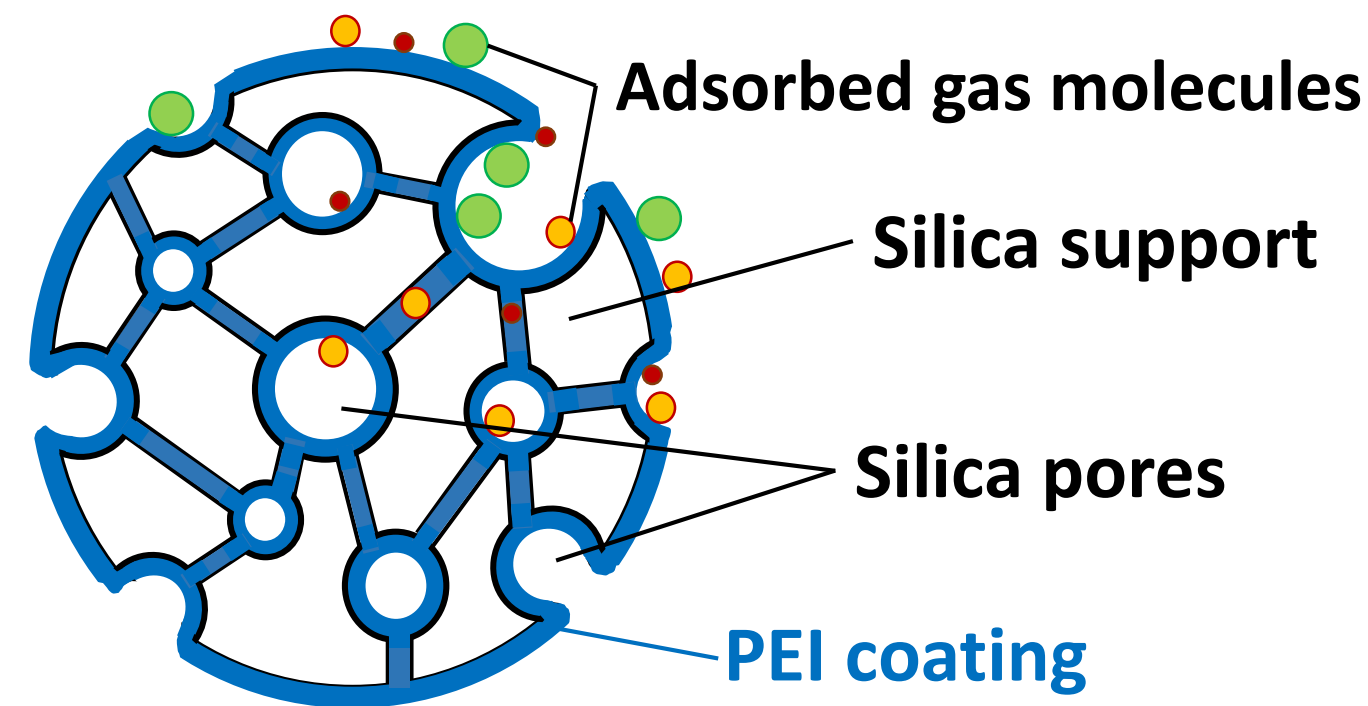
Incorporate optimized adsorbent into affordable end-product materials (e.g. coatings, foams)

The **APACHE Project** focuses on developing new materials and intelligent enclosures to detect and prevent unsuitable environments for cultural heritage. The project is funded by the European Commission (Grant Agreement 814496).



## Adsorbent Development:

A silica gel adsorbent is physically loaded with polyethylenimine (PEI) to coat the pore surfaces.



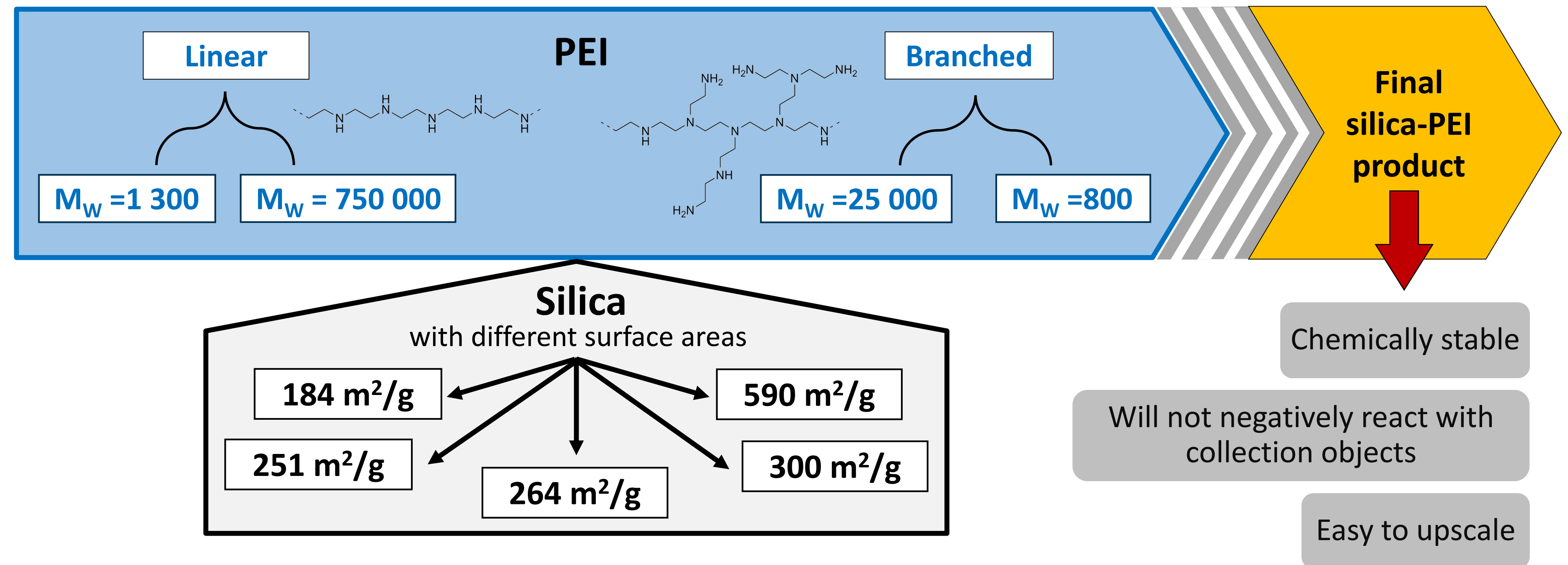
### Why silica gel?

- Porous material: high surface area for efficient adsorption
- Affordable and readily available
- Chemically inert material

### Why PEI?

- Captures a range of acidic gases, including many pollutants known to deteriorate museum objects
- Easy to physically load onto silica
- Affordable and readily available

Currently investigating **five** different types of silica gel and **four** different types of PEI loaded at varying percentages:



## Ongoing and future analysis

### Lab tests:

- Surface area, post-loading (*Brunauer-Emmett-Teller*)
- Texture (*scanning electron microscopy*)
- Adsorption isotherms for 7 gases (*in situ mass spectrometry*)
- Adsorption mechanisms for 7 gases (*in situ infrared spectroscopy*)
- PEI loading (*thermogravimetric analysis*)

### Field tests:

- Collaborations with cultural heritage institutions
- Measurements of air quality before and after adsorbent installation