

An air pollutant filter system to prevent tarnishing of silver decoration on a wooden cabinet

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The *Walbaum Cabinet* at the Kunstgewerbemuseum (Museum of Decorative Arts), Berlin is made from ebony and has extensive silver decoration. This masterpiece by Matthias Walbaum was made around 1600–1615. All of its over 3400 individual silver parts were dismantled and cleaned of tarnish before it went on display in a new showcase at the Köpenick Palace in 2013. A solution was sought to prevent the future buildup of silver tarnish. It was decided not to lacquer the silver surface; instead, a system was used which aims to prevent tarnish buildup by filtering out air pollutants (e.g. H₂S) which cause the alteration of the silver surface. A new low-emission showcase of glass and metal was made for the cabinet. The environmental air and the cabinet's own organic materials (mainly wood and some silk) were identified as the predominant sources of air pollutants. The display area has a volume of 1050 mm (height), 1920 mm (width) and 1000 mm (length). An air pump (KNF, Freiburg, Germany, Model: N920 AP.29.18) with a filter unit was installed in the technical compartment. The filter unit comprises a chemical and dust filter. The chemical filter (Artemis Control AG, Uster, Switzerland, Model: CRD-AB_{ix}CTs-220x105) was purpose-built for this application and filters acids, bases, sulphur compounds and volatile organic carbons. The dust filter is a membrane filter (47 mm in diameter) with a 1-µm pore size and was connected in series to the chemical filter module. Smaller pore sizes will result in a higher flow resistance. The air inside the showcase circulates within a closed circuit. Five outlets and inlets (~5 mm inner diameter) on the left and right sides of the cabinet, respectively, connect the filter system via a FESTO tube to the display area. To ensure a good intermixture between the filtered air and the inside air volume, an adequate velocity of inflowing air is required. Simulations by the Technical University Berlin, Department of Fluid System Dynamics (carried out by M. Steffens) showed that an air flow rate of 11.5 l/min was appropriate. The performance of the installed filtering system was evaluated by air pollutant measurements. Baseline test measurements had been carried out in the new showcase before the chemical air filter was installed. The acetic acid concentration of the air inside the showcase was taken as the filter performance indicator. Measurements of the other relevant air pollutants were not possible with the laboratory equipment or (as for SO₂) were found to be below the limit of detection for the baseline test. The test showed a significant reduction in the acetic acid level. From a baseline level of 925 µg/m³, the value was reduced to about 100 µg/m³. As an additional monitoring tool, a silver coupon was placed in the showcase and checked regularly for any change in colour. To date, no significant colour change has been observed. A disadvantage of this approach is the noise from the pump. The sound is audible as an undertone if the showcase is closed.

An air pollutant filter system to prevent tarnishing of silver decoration of a wooden cabinet

Stefan Röhrs

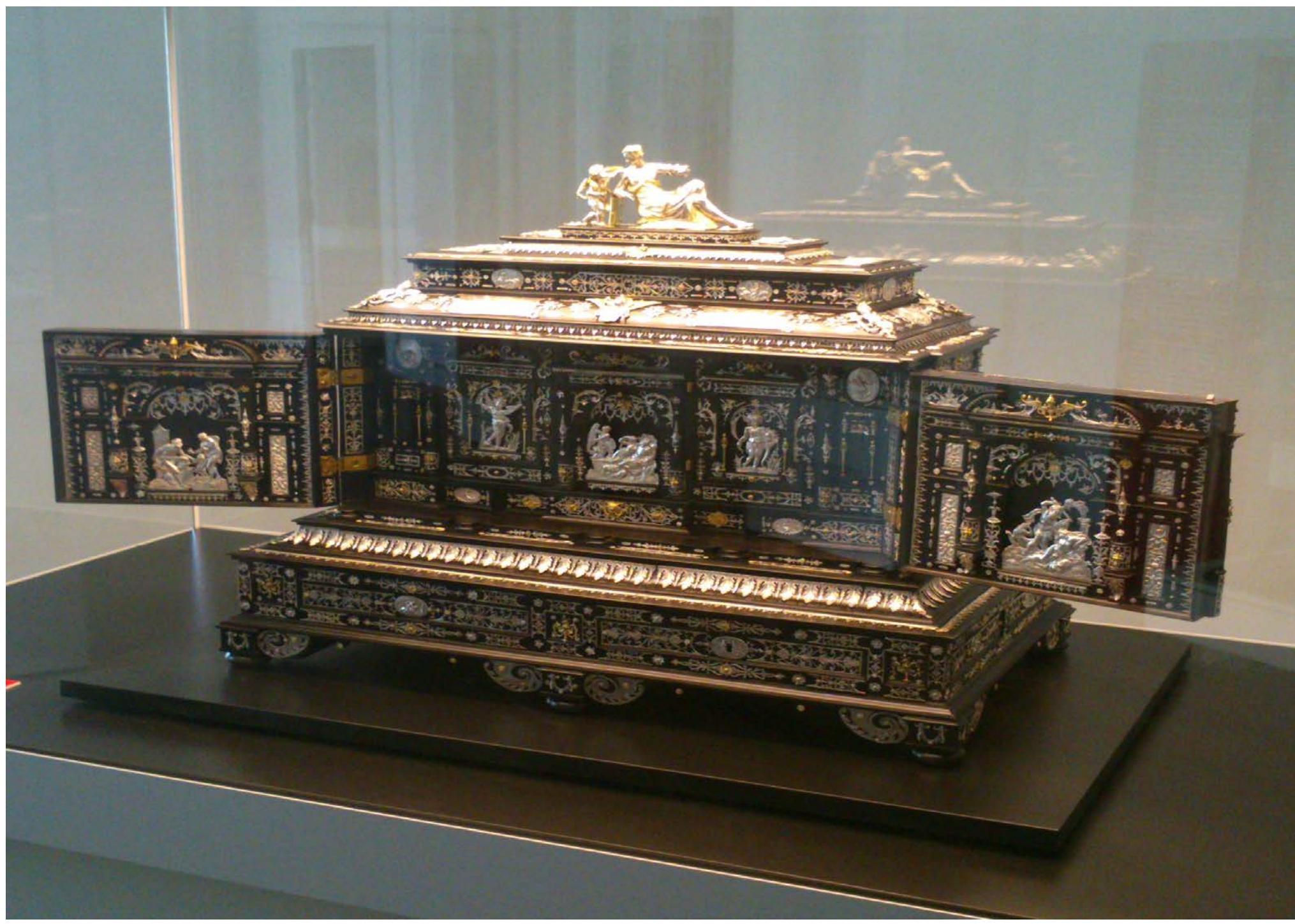
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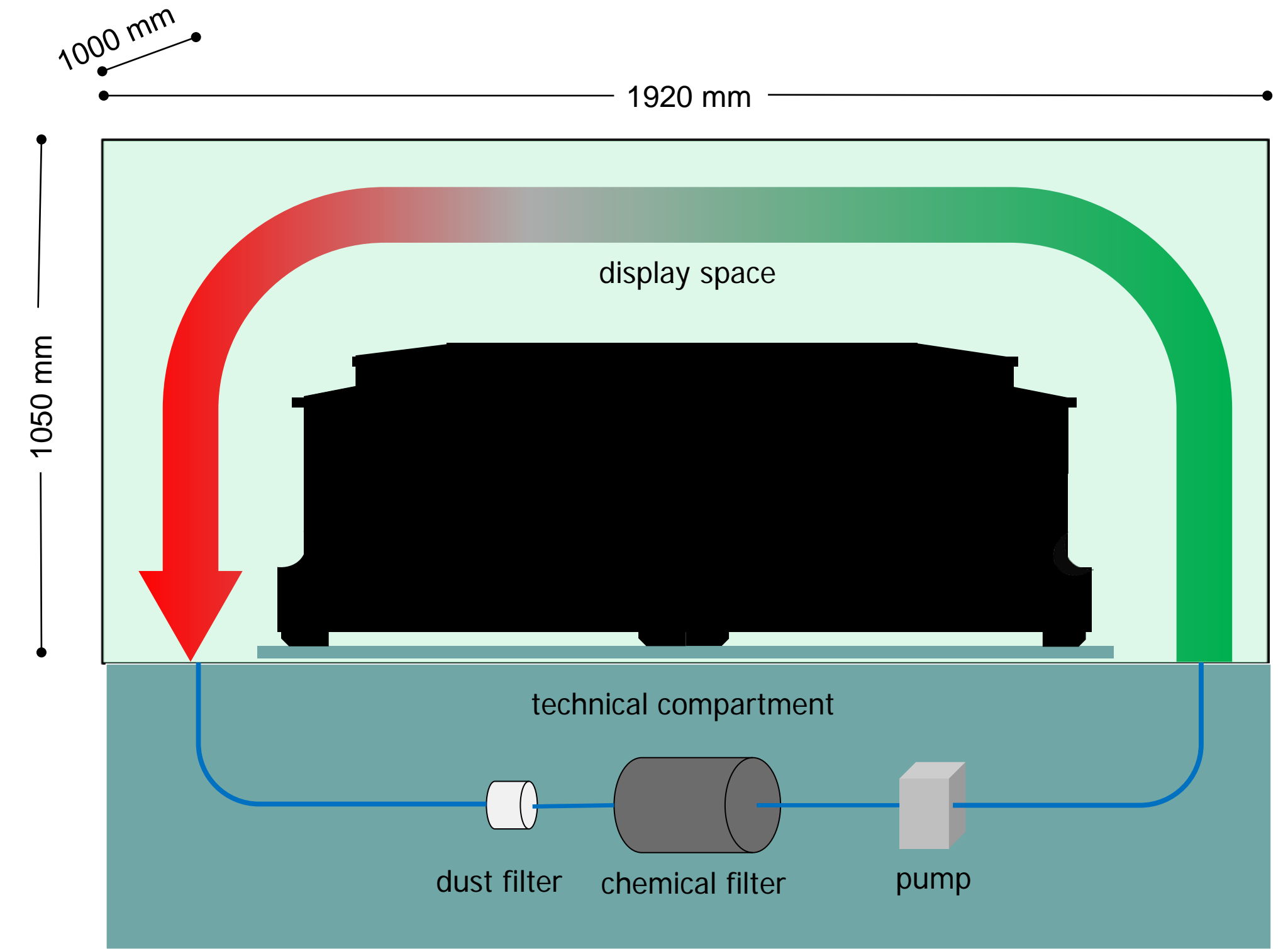
Kunstgewerbemuseum, Staatliche Museen zu Berlin, Tiergartenstraße 6, 10785 Berlin, Germany

How to prevent silver tarnishing of an object with more than 3,400 individual silver parts?

INTRODUCTION

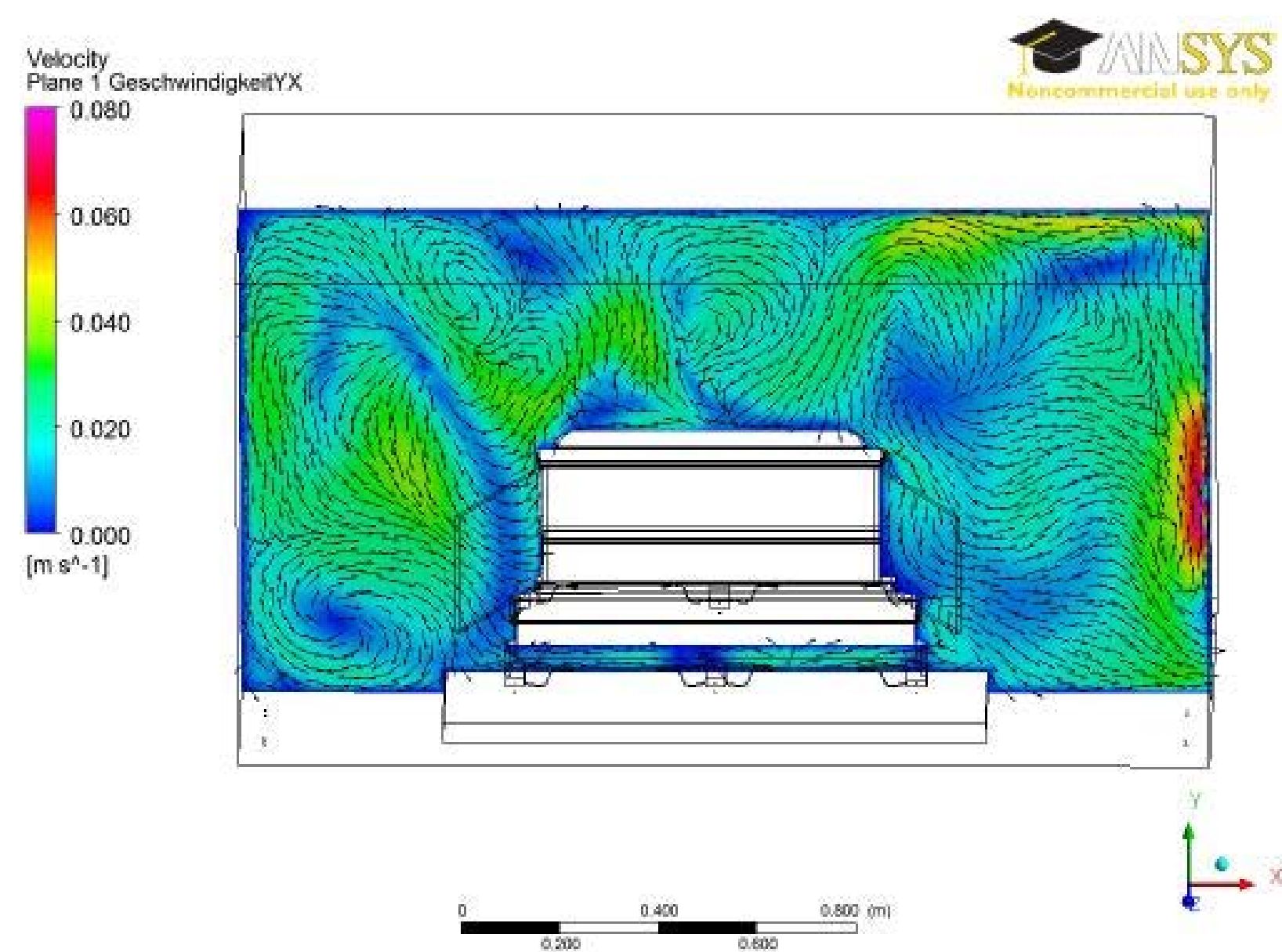


The 'Walbaum-Cabinet' of Kunstgewerbemuseum, Berlin is made from ebony and has extensive silver decoration and was made by Matthias Walbaum around 1600-1615. All of its over 3,400 individual silver parts were dismantled and cleaned from tarnish before it was going on display in a new showcase. A solution was sought to prevent the future build-up of silver tarnish. It was decided against lacquering of the silver surface. A system which aims at preventing tarnish build-up by filtering-out air pollutants (e.g. H₂S) is used.



Scheme of the showcase

CONFIGURATION



Air flow simulation was used to model the intermixing of the clean filtered air with the air around the furniture.

(Simulation by Matthias Steffen, Tino Mengdehl, Department of Fluid System Dynamics, Technische Universität Berlin)

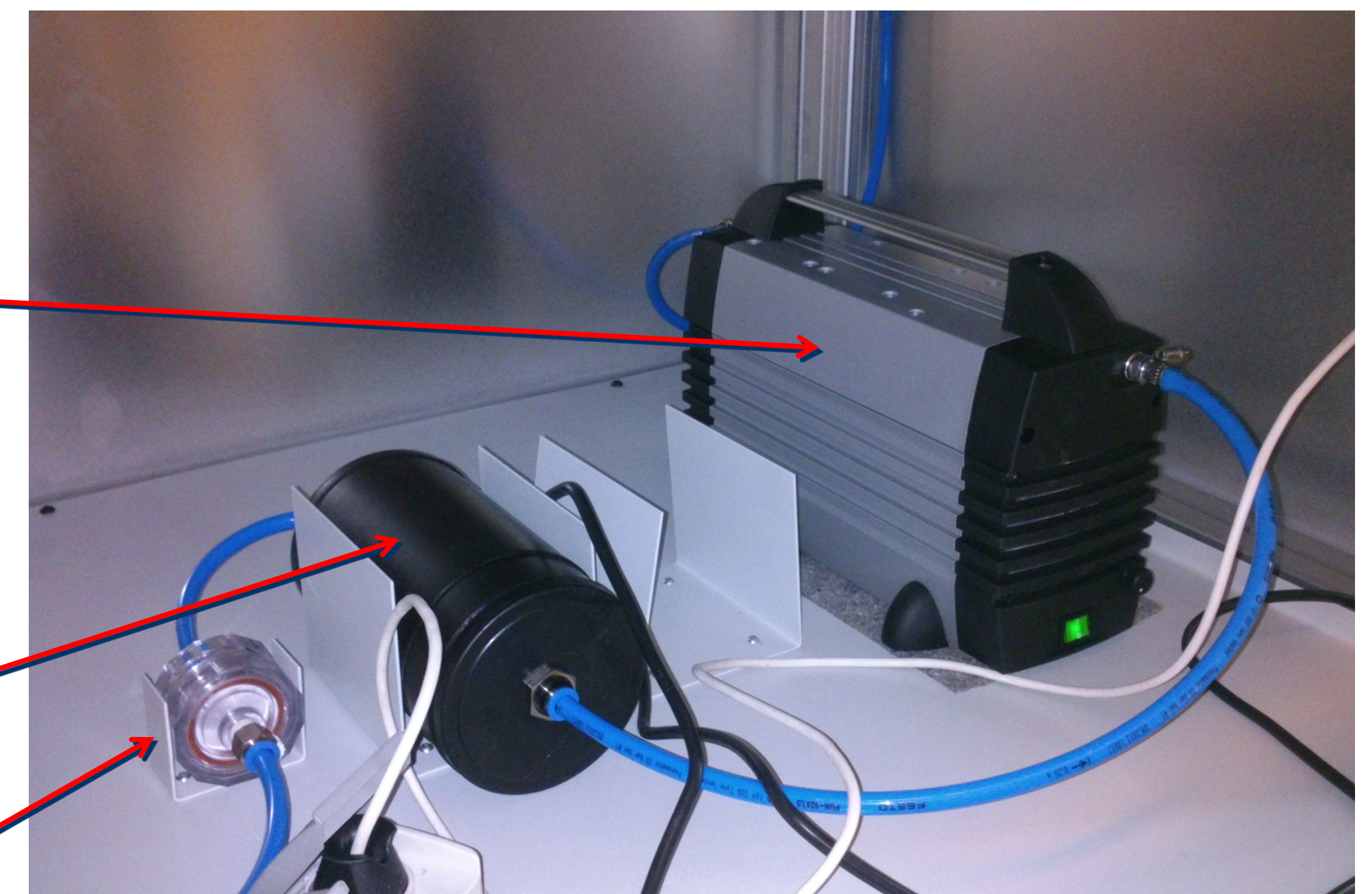
We try with pump ...

Membrane air pump KNF®, Freiburg, Germany, Model: N920 AP.29.18

and filters

The chemical filter was purpose-build for this application: Artemis Control AG®, Uster, Switzerland, Model: CRD-ABIXCTs-220x105. Filtering acids, bases, sulphurs compounds and volatile organic carbons.

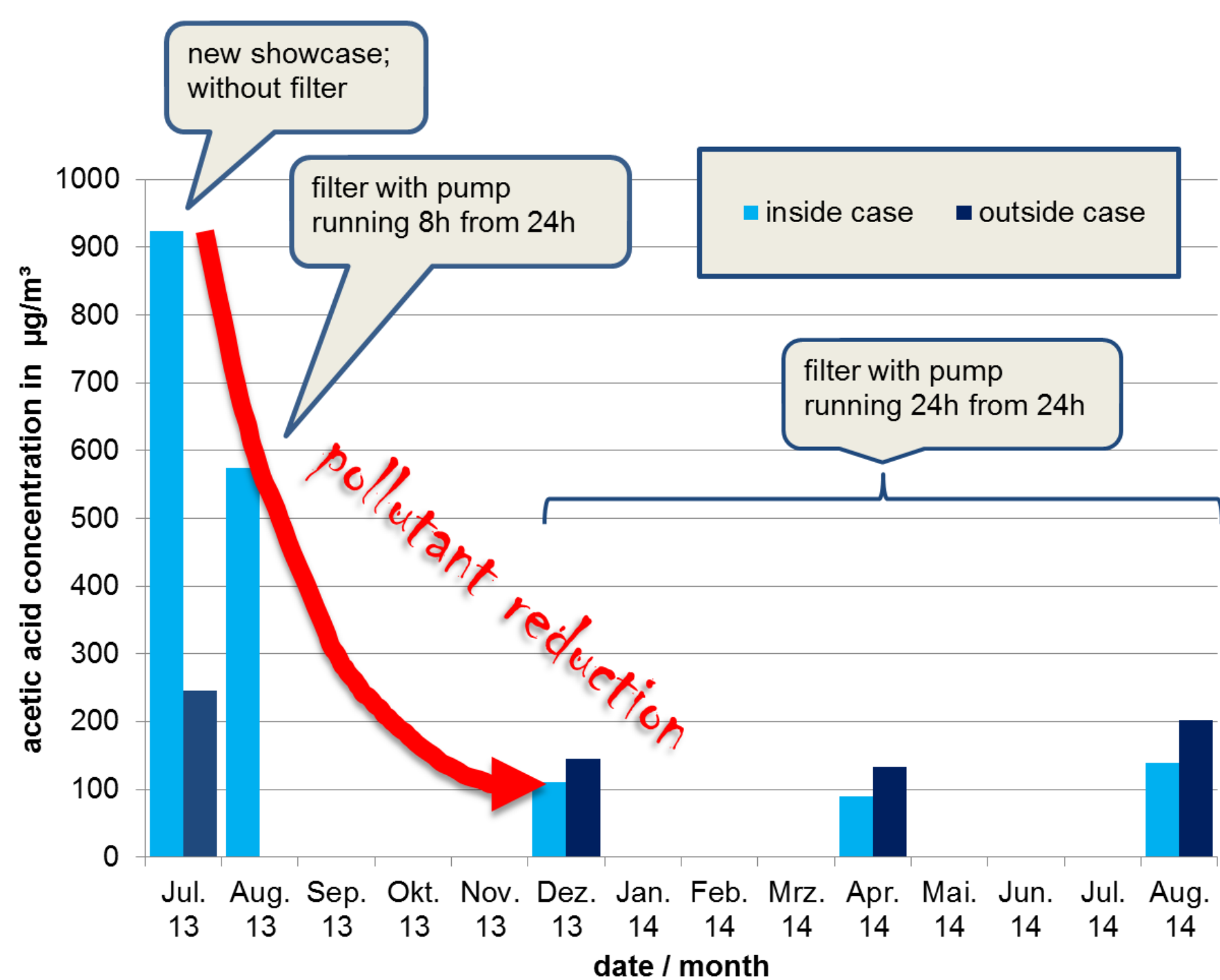
A membrane filter is used as dust filter.



View into the technical compartment of the showcase

RESULTS after one YEAR

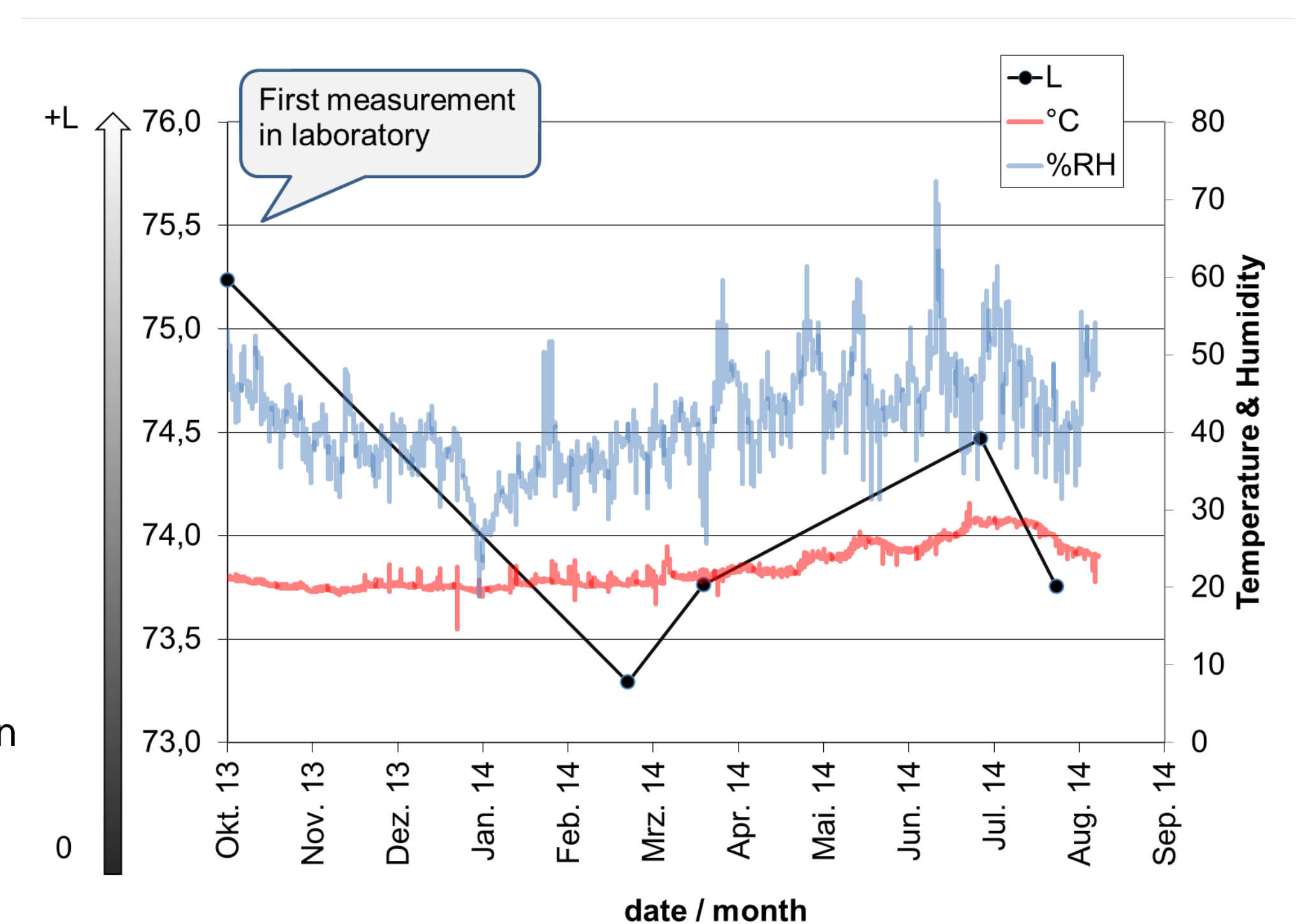
The pollutant level inside the showcase had been reduced



Measurement of acetic acid concentration as indicator of the performance of the filtering system. Values are compared to room air.

Colour change of a silver coupon placed in the showcase is monitored

Colour measurement values of a silver coupon inside the showcase given in L*a*b* colour space values. L* values and climate date from the exposition room are shown.



No distinct colour change of the silver has been observed. After this successful start with, we will continue to monitor.