A Presentation of

a New Experimental Test Method for Humidity Buffers – A Comparison of two Silica Gels, Artsorb and Prosorb

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Introduction

The method presented in this poster was developed as a part of the MSc graduating thesis at the Department of Conservation, Göteborg University, Sweden [1]. An experimental test method was developed for the purpose of comparing two silica gels, Artsorb [2] and Prosorb [3], but the method may also be used for other humidity buffers. Both products are developed for museum applications and have been used as humidity buffers in showcases at The National Museum of Fine Arts in Stockholm during the last few years. At the museum, the RH has been monitored [4] in showcases containing Artsorb and Prosorb. Both products have so far shown equally good results in keeping a satisfactory constant relative humidity. Questions on silica gel in general and Artsorb and Prosorb in particular have been, how much silica gel is needed for a specific showcase and for how long will it keep a constant humidity?
However, the objective of making the tests was to compare their humidity buffer properties, not to find their optimal capacity.

Experiments

The experiments took place in an unclimatised room at The National Museum of Fine Arts during a period of six consecutive months. The seasonal fluctuation in this part of the building ranged from 10 % RH in winter to 70 % RH in summer, so the test results could not be compared. To achieve controlled testing parameters, an airtight showcase was used to simulate a controlled room environment as shown in fig 1.

(Fig 1)
The experiment set up in the showcase.

An airtight showcase was used so simulate a controlled room environment. Within, open glass containers with saturated salt solutions of lithium chloride (LiCl) and sodium chloride (NaCl) provided a low and high RH respectively. Two additional desiccators were placed inside the showcase and were used as testing chambers for the silica gels. Lids were custom made acrylic plastic and perforated with 20 holes. By covering a given number holes, a controlled air exchange rate between the test chambers and the surrounding showcase environment was enabled.

Photo: Hans Thorwid, The National Museum of Fine Arts Stockholm.

During a serie of pre-tests [1], the amount of silica gel, salt solution, and number of open holes where developed for the actual tests. A SEM-EDS analysis [5] confirmed the manufacturers' data on Artsorb containing the highly soluble and corrosive salt lithium chloride (LiCl) [6], whereas Prosorb contains aluminium oxide (Al_2O_3). The air exchange rate, tested as described by Calver et al. [7], was 4,6 times/day. RH and temperature were monitored [6] during the tests in the two desiccators as well as in the showcase.

In total four test series were performed (Fig 2). Each test ran for three separate weeks. The pre-tests showed difficulties to reach the reconditioned RH due to the high air exchange rate. The lids of the desiccators were therefore carefully covered by two layers of plastic foil during the first 24 h (interval A-B in the diagrams below.)

(Fig 2) **The four test series performed.**

Test no.	Artsorb and Prosorb reconditioned	Showcase climate during test
1	70 % RH	15 % RH
2	50 % RH	15 % RH
3	50 % RH	75 % RH
4	30 % RH	75 % RH

Result and discussion

Within the timeframe of the research project, the test series were only carried out once, which is why the results are not conclusive or verified. However, preliminary results indicate the following:

In general none of the two silica gels did clearly show better results than the other.

When reconditioned to 50 % RH (tests 2 and 3), Artsorb presents better results in a humid climate and Prosorb in a dry climate. Possibly Artsorb's performance is due to the content of LiCl, as this salt has a pronounced desiccative property.

When reconditioned to 30 % and 70 % RH (tests 1 and 4), the results did not follow this tendency but the two silica gels had greater difficulties in keeping a constant humidity. This stresses the necessity of using larger quantities of silica gel under more harsh conditions than recommended by the manufacturers or using more airtight showcases. This is also demonstrated by the fact that the plastic foil worked successfully when the silica gel was reconditioned to 50 % RH but did not work satisfactory when reconditioned to 30 % and 70 % RH. Using plastic foil must be looked upon as an emergency expedient.

The result in test 1 showed a sudden drop (both silica gels, from approximately 60 % RH to below 30 % RH) when the plastic foil was removed. The drop could be explained by stack pressure. Although, why the RH remained low for more then a week and then suddenly rose again to 65 % RH could not be explained within this study.

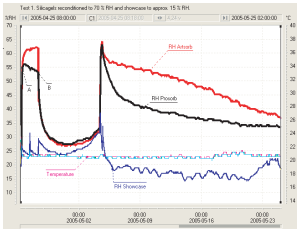
The regulated showcase climate shows that it is more difficult to keep a stable humidity at low RH (15 % or below) than compared to a higher RH (75 %) using the same amount of saturated salt solutions.

Although the method needs to be further tested and evaluated, it shows potential to be a useful tool in comparing different humidity buffers and their ability to keep a constant relative humidity in museum showcases. The method is inexpensive and easily enables reproducibility within most museum environments.

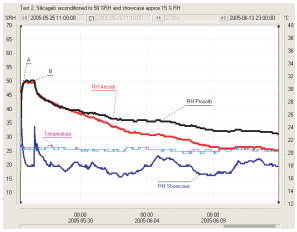
(Fig 3) **Result of tests.**

During the initial interval A-B in the test series as seen in the four diagrams the desiccators were covered with plastic foil.

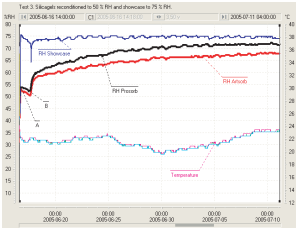
Result of test no 1.
Silica gel reconditioned to 70 % RH in a showcase climate of 15 % RH.



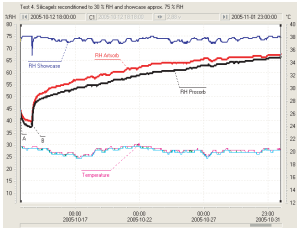
Result of test no 2.
Silica gel reconditioned to 50 % RH in a showcase climate of 15 % RH.



Result of test no 3.
Silica gel reconditioned to 50 % RH in a showcase climate of 75 % RH



Result of test no 4.
Silica gel reconditioned to 30 % RH in a showcase climate of 75 % RH.



References

[1] Bylund Melin, C. (2005) ART-SORB® & PROSORB. En jämförande studie av två fuktbuffrande kiselgeler och utvärdering av en ny försöksmetod. (In Swedish).Göteborgs universitet.

[2] Fuji Silysia Chemical Ltd., Japan. (http://www.fuji-silysia.co.jp/english)

[3] Long Life for Art, Germany. (http://www.cwaller.de)

[4] TinyView Plus, humidity and temperature logger. Producer: Intab. (http://www.intab.se)

[5] LEO-1455VP equipped with a LINK/EDS-unit, Inca 400, for micro X-ray analysis.

[6] Dupas, M., Salies, A., and De Witte, E. (1987) The presence of soluble salts in silica gel. In: ICOM Committee for Conservation. Preprints, vol. III. 8th Triennial Meeting. Sydney, Australia 6-11 Sept. 1987, pp. 867-869

[7] Calver, A., Holbrook, A., Thickett, D., Weintraub, S. (2005) Simple methods to measure air exchange rates and detect leaks in display and storage enclosures. In: ICOM Committee for Conservation: 14th Triennial Meeting, The Hague, 12-16 Sept. 2005. Preprints. Vol. II, p. 597-609.