MIXING IT UP: AN INVESTIGATION INTO 'LOW-TECH' METHODS FOR RECONDITIONING SILICA GEL

Rebecca Gridley[1] and Steven Weintraub[2]

[1] The Conservation Center of the Institute of Fine Arts, New York University [2] Art Preservation Services, New York

INTRODUCTION

Silica gel is used to maintain relative humidity (RH) within a specific range inside storage and display enclosures. To act as an effective buffering agent, it must be preconditioned to a specific moisture content. Depending on exposure duration, microclimate leakage rate, and external environmental conditions, the RH within the enclosure may drift out of the desired RH range when the buffering capacity of the silica gel is exhausted.

Silica gel can be reconditioned and reused. Reconditioning methods typically require specific equipment or laboratory conditions and dedicated staff. Purchasing preconditioned replacement material is expensive and adds unnecessarily to an existing stock of silica gel.

Our experiments respond to the need for simple procedures that would allow collections care professionals to recondition silica gel 'in-house.'

OBJECTIVES

Is it possible to recondition silica gel *with* silica gel? That is, can batches of silica gel with different initial RH values be mixed together to obtain a new desired RH value?

Can costs can be reduced by using widely available and relatively inexpensive equipment?

PROCEDURE

These experiments simulated real world scenarios on a small scale:

- Silica gels with different RH values were mixed together in various proportions.
- Mixtures were placed in plastic containers and regularly agitated to ensure thorough mixing.
- RH of the air above the silica gel mixture was monitored using digital hygrometers. Initial trials included color-indicating silica gel to visually monitor equilibration rates and determine amount of time required for the reconditioning experiments (5-7 days).

EQUIPMENT:

- Onset HOBO® dataloggers and inexpensive Pocketech hygrometers (designed for 'home use'). The response of all devices was first compared across a wide RH range.
- Small plastic containers with different levels of air-tightness.
- Colorless, high performance RHapid GEL and methyl-violet color-indicating regular density silica gels.

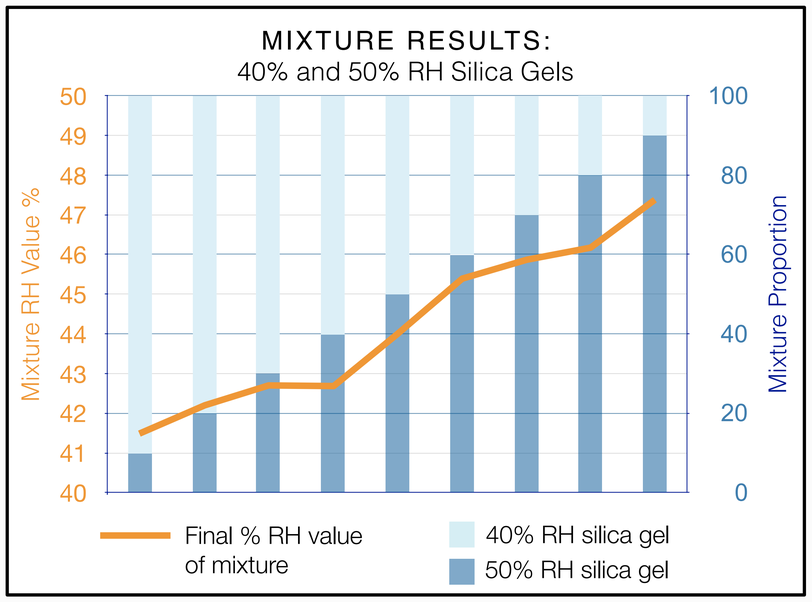
RESULTS

Trials and results fall into two categories:

1. Final RH values of mixtures of silica gels preconditioned at 'extreme' values show a non-proportional relationship:
   - 50 : 50 mix of 5% RH : 70% RH will *not* yield the average RH value of the two mixture components.
2. Final RH values of mixtures of silica gels preconditioned within a mid-range value (30%-60%) show a proportional and roughly linear relationship, as illustrated in the below **graph**:

MIXTURE RESULTS: New RH Values (% RH)

	Preconditioned silica gels mixed (Dry : Saturated)	Proportions of silica gel mixtures			
		80 : 20	*60 : 40*	*40 : 60*	*20 : 80*
1	5% RH : 70% RH	22	37	48	53
	5% RH : 60% RH	23	30	42	51
2	30% RH : 60% RH	40	44	50	56
	40% RH : 60% RH	44	47	52	54
	30% RH : 50% RH	38	39	41	47
	30% RH : 40% RH	35	37	38	39



- Results are explained by the change in buffering capacity of silica gel at varying RH values: when silica gel is preconditioned to 5% it performs differently than when it is preconditioned to 40% or to 70% RH.
- Different types of silica gel (high performance vs. regular density) will show a non-proportional relationship when combined.
- The target RH value of the overall mixture may be achieved quickly (1-2 days); complete equilibration is contingent upon the difference in moisture content of individual beads in the mixture and requires more time (about 7 days).

CONCLUSIONS

'RECONDITIONING BY MIXING'

- Effective for obtaining a new RH value within a general target RH range (e.g. goal is 40-50% RH).
- Additional mixing steps may be necessary if a specific RH value is required (eg. goal is exactly 45% RH), prolonging the reconditioning process.

ASSESSMENT OF EQUIPMENT

- Digital hygrometers made for 'home use' are great tools but have limitations: no logging capability, limited measurement range (20-70% RH), precision drifts outside 30-50% RH, and accuracy may be off by 1-4%.
- Inexpensive plastic containers that are not extremely airtight can be modified with barrier films for the short-term reconditioning process.

APPLICATIONS

- *To recondition large batches of silica gel in use*: remove a small portion, recondition to an extreme RH value (<5% or >60%), and mix it back in to shift the RH value of a larger batch down or up, respectively.
- *To create 'custom' microclimates with specific RH needs*: mix together portions of silica gel preconditioned to different RH values to get within range of target value, and 'zero in' on target with additional mixing steps if necessary.

AUTHORS

Rebecca Gridley reg343@nyu.edu
Steven Weintraub steve@apsnyc.com

NYU INSTITUTE OF FINE ARTS

APS NYC ART PRESERVATION SERVICES

ACKNOWLEDGEMENTS

FAIC George Stout Memorial Grant, IFA Connoisseurs Circle, Lisa & Bernard Selz, Hannelore Roemich