METHODS FOR RECONDITIONING SILICA GEL

1. CONDITIONING SILICA GEL OUTSIDE THE EXHIBIT CASE

REMOVING MOISTURE

The most efficient method of removing moisture is with heat. Although silica gel has a very high melting temperature (1600º C), it will lose its chemically bound water and hygroscopic properties if heated above 300º C. In addition, there is a new class of indicator gels, incorporating organic dyes that are heat sensitive and their color indicating dye will be effected above 125-150º C (Goldberg and Weintraub 2001). Therefore, it is not recommended that indicating silica gel be heated above 120º C and regular gel be heated above 200º C. The principle impact of a lower heat of regeneration is that a longer time is required to dry the gel and there is less potential for the degradation of silica gel properties.

In a conventional oven, the time of regeneration varies from minutes to hours, depending on temperature and the thickness of the gel. Although silica gel can be dried in a microwave oven, it is difficult to determine the temperature inside the gel. Also, since metal cannot be used in a microwave oven, only glass, ceramic or microwave safe plastic with a high melting temperature should be used to hold the gel, since the individual beads can become very hot.

ADDING MOISTURE

The simplest method for conditioning silica gel is to place it in a room or environmental chamber set to the desired RH level. The best method of confirming that the silica gel is at the correct RH is by measuring the RH of a sample batch of gel. This is done by placing the sample gel in a sealed container or plastic bag with a hygrometer (use a large amount of gel relative to the surrounding air), and allow a day for the RH within the bag to stabilize with the gel mixture. Although an approximate RH value can be calculated based on weight, this method is not recommended because of its margin of error.

- Methods of speeding up conditioning time:
    - Spread the gel as thin as possible.
    - Use a fan to circulate air around the gel.
    - Periodically mix the gel layers to improve uniformity.
- For a single layer of bead, allow at least 4 days if the gel is initially dry, and longer if spread as a thicker layer.
- Silica gel can be conditioned to a higher RH than the desired level, either to speed up the conditioning process or because of the inability to control RH. If so, it is important to allow 2-3 day for the moisture to equilibrate within and between the gel beads, especially if beads with different moisture contents are mixed together.

- The direct addition of water through mist spraying or immersion is not recommended, since the high heat of decrepitation causes silica gel beads to crack and fragment. Although silica gel retains its hygroscopic properties, the overall response time of silica gel in a tray will slow down because of denser packing from the mix of large beads and smaller fragments.

2. METHODS FOR CONDITIONING SILICA GEL WITHOUT REMOVING IT FROM THE EXHIBIT CASE

Silica gel in cases can be reconditioned by adding water or appropriately conditioned silica gel to the case. This method is very effective if the silica gel is spread into a very thin layer, or has a very fast response time, such as is achieved with Rhapid Gel. Otherwise, only the upper layer of silica gel will be conditioned and there is a risk that the RH within the case will rise or fall too quickly, without adequately conditioning the full bulk of silica gel.

Increasing or decreasing surface area can control the rate of water evaporation. If there is concern about placing water directly in a case, or if a fast rate of evaporation is desired, a saturated humidifier wicking pad, preferably one treated with an antimicrobial agent, can be used. Generally, water will evaporate more rapidly in this manner because of the extended surface area of the wicking pad compared to a dish of water.

The initial speed at which dry gel removes excess moisture is very fast. It is important to limit the surface area of dry gel to prevent the case RH from dropping too quickly. This is because the speed at which dry gel adsorbs moisture is faster than the rate at which silica gel desorbs moisture.

If silica gel is conditioned in place, the rate at which the RH rises or falls within the case must be carefully monitored in order to determine if the rate is acceptable and when the water or dry gel that was placed in the case to condition the main supply of silica gel must be removed.

It is possible to calculate how much moisture must be added or removed to recondition silica gel in place (Lafontaine 1984, Weintraub 1991). It is important to take into account the impact of other hygroscopic materials inside the case. With experience, adjusting the amount of water or dry gel required may be required to compensate for other hygroscopic materials.

CALCULATE THE AMOUNT OF WATER REQUIRED TO INCREASE RH:

Multiply the % increase in RH required, the M_H value of the silica gel, and the weight of silica gel within the case.

For example, if the goal is to raise RH from 45% to 55% in a case containing 2 kilograms of silica gel with an M_H of 9, 180 grams of water is required:

10% RH x 9 (M_H) x 2 kg = 180 grams of water

CALCULATE THE AMOUNT OF DRY SILICA GEL REQUIRED TO DECREASE RH:

- Step 1 - Determine how much moisture must be removed by multiplying the % decrease in RH required by the M_H value of the silica and the total amount of silica gel within the case.

- Step 2 - Establish the EMC adsorption value for the dry gel at the desired RH set-point and multiply this value by 10, to convert the value to the amount of moisture that can be removed per kilogram of dry gel.

- Step 3 - Divide the amount of water to be removed (Step 1) by the amount of water that can be removed by a kilogram of dry gel (Step 2). The result is the total amount required to recondition the silica gel in place.

  For example, the goal is to lower RH from 55% to 45% in a case containing 2 kilograms of Rhapid Gel (M_H = 9). If the dry gel is a regular density silica gel (EMC = 25% at 45% RH), the amount of dry gel required is 0.72 kilograms:

  1) 10% RH x 9 (M_H) x 2 kg = 180 grams of water
  2) 25% EMC x 10 = 250 g of moisture per kg of silica gel at 45% RH
  3) 180g/250 g = 0.72 kilograms

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