

Improving Silica Gel Reactivation

Silica gel desiccant reactivation is a common operating procedure regularly used and performed to remove moisture from saturated material.

Silica gel is used throughout industry to adsorb moisture and maintain low relative humidity thereby preventing product contamination and degradation. Silica gel is capable of adsorbing up to 35% of its own weight of water vapor.

The majority of Transformer Breathers used by the power generation industry contain indicating silica gel.

Silica gel is available in two primary types, indicating and non-indicating. The indicating property is achieved by impregnation with cobalt chloride salt which is sensitive to water vapor.

Ineffective reactivation control can result in Transformer Breathers being serviced by up to three times more than is necessary.

Shorter maintenance periods have an impact on both time and cost.

The use of valved Transformer Breathers has eliminated the need to maintain the oil seal fluid level and combining this with improved reactivation contributes to further savings by extending the average maintenance period.

This article suggests a number of simple improvements to improve the practice and procedures for reactivation of silica gel.

Indicating Silica Gel

Indicating silica gel is used throughout the power generation and transmission industry for Transformer Breathers to protect the heat transfer cooling oil from moisture (condensed water) contamination. The indicating color provides a quick, efficient and easy way to tell when the desiccant is approximately halfway saturated.

One of the principal reasons for the use of indicating silica gel is its ability to release adsorbed moisture when heated to a temperature of over 212°F (100°C). This means it can be regenerated and used again.

Indicating silica gel can theoretically be reactivated many times. This will depend on several key factors, including the environmental conditions during use, the reactivation temperature and reactivation procedure.



The Reactivator unit being filled with cobalt chloride impregnated silica gel

1005 Desiccant Reactivator Unit

Although this may seem a simple procedure, inadequate control and poor process techniques can have a major impact on maintenance schedules by reducing the average time between reactivation and replacement of exhausted indicating silica gel.

Indicating silica gel is a silica-based material capable of adsorbing 35% of its own weight in moisture. The most widely used indicating silica gel is impregnated with cobalt chloride that gives the silica gel its saturation indicator, changing from a blue color to pink when a 10-12% moisture loading (by weight) of the desiccant is exceeded.

Beaded indicating silica gel is the best material to use in transformer breathers as it provides high resistance to attrition (dusting breakdown) during handling and regular bed packing providing uniform flow rate characteristics.

The saturation indicator changes from a blue color to pink when the silica gel requires reactivation or replacement. The saturation indicator can be directly related to the equilibrium relative humidity of the fluid (oil). Maintaining the moisture level of oil to a maximum content of 15 PPM is a typical requirement.

The alternative to cobalt impregnated silica gel is orange silica gel, which can also be safely reactivated.

Warning: It is an essential safety requirement that the outlet exhaust vent from the reactivation equipment is piped to the outside of the building/room into an adequate ventilated space.

If you require any specific advice for reactivation of desiccants, please call us at 800-995-5590 or e-mail us at sales@desiccantcity.com.



The 1005 Reactivator being filled with orange silica gel.

1005 Desiccant Reactivator Unit

Possible Problems

One or a combination of the following factors can affect effective reactivation:

- Failure to achieve a uniform temperature of more than 212°F (100°C) throughout the entire silica gel desiccant used.
- An inadequate supply of hot air to carry away the moisture driven off during reactivation.
- Considering the reactivation process is complete when the activity indicator of the silica gel displays an active color.
- Overheating during reactivation which can cause damage to the desiccant structure reducing the moisture adsorption capacity.
- Use of the wrong type of equipment for reactivation.
- Attempting to reactivate silica gel, which has been contaminated with oil.
- Not storing reactivated silica gel in a sealed airtight container.

Industrial Examples

There are a number of examples of poor reactivation processing currently used in industry. Many poor reactivation procedures derive from a less than clear understanding of simple procedures and controls required which will considerably improve the reactivation process.

Many users consider placing silica gel in a warm oven as an adequate method to remove the adsorbed water.

The use of gas ovens should be avoided and microwave cookers are likely to damage the structure of the silica gel.

The Effects

Silica gel which has been subjected to temperatures in excess of 302°F (150°C) is likely to be discolored to a brown or blackened state. If the silica gel has been subjected to overheating the adsorption capacity will have been adversely affected.

If silica gel that has been contaminated with oil is reactivated, the adsorption capacity will be affected and the oil contamination could be readily transferred to silica gel contained in the reactivation unit.

1005 Desiccant Reactivator Unit

Silica gel, which has a brown color and emits odor during storage or reactivation, is often an indication of contamination.

The reactivation of contaminated desiccant causes the oil to solidify within the structure of the desiccant resulting in a 50% reduction in adsorption capacity.

Health and safety consideration must always be given to the reactivation of silica gel.

It is an essential safety requirement that the outlet port of the reactivation equipment is vented to an atmosphere which is external of the workshop or facility where the process is being carried out.

The use of an adsorption filter may also be necessary if there is a risk that unidentifiable contaminants may be expelled during reactivation.

Silica Gel Activity Saturation Indicator

One of the most important factors (listed above) to understand is the meaning and purpose of the activity indicator.

When new or replacement desiccant is supplied by the manufacturer, the desiccant will have a maximum moisture loading of 2% by weight.

The desiccant will, therefore, adsorb 10% moisture which will cause the activity indicator to change from a blue color to pink.

At this time, the desiccant must be recharged or replaced.

The activity indicator changes color on a narrow band of approximately 2% moisture content and this is the primary cause of poor desiccant reactivation.

When the desiccant is heated, the activity indicator will change from its saturated color to its active color early in the reactivation process as a consequence of the narrow change band.

If the desiccant is considered to be reactivated at this time the residual moisture loading could be as high as 10%. The desiccant has therefore not been reactivated to remove the adsorbed moisture to the 2% level as supplied by the manufacturer.

When the desiccant that has been poorly reactivated is used, the activity indicator will change rapidly from the active color to saturated indication depending on the duty cycle and the weather.

The desiccant will require reactivation and so the cycle begins again at much shorter intervals than the original desiccant charge.

1005 Desiccant Reactivator Unit

Any of the above factors for poor desiccant reactivation will have a similar result of the activity indicator changing rapidly following reactivation.

Improving the reactivation process is simple and often only requires a modification to existing procedures.

The Solution

When reactivating desiccant, it is vital that the activity indicator is not used to control the process as previously discussed.

1. As a general rule, saturated desiccant will require a minimum of 4-6 hours at a temperature of between 105-110°F throughout the entire desiccant bed for the reactivation process to be effective and reduce the adsorbed moisture to less than 2% by weight.

Caution: Some desiccants are seriously damaged and can release toxic chemicals if overheated.

2. Reactivation should be carried out in a ventilated electric oven. A sealed oven will limit the moisture liberated and prevent efficient reactivation. Gas ovens and microwave cookers are not suitable for reactivation.
3. Devices that pass warm air through the desiccant bed changing the activity indicator to blue should be avoided.
4. Ideally, after reactivation the desiccant must be placed in a sealed container and allowed to cool. The reactivated desiccant should not be stored in a warm oven at 60°F as this will cause partial saturation of the desiccant although the activity indicator may indicate the desiccant is active.
5. To validate reactivation efficiency, a fundamental weight loss test conducted before and after processing will provide the data to calculate the amount of moisture loss.
6. A supply of pre-heated air is an integral requirement for an efficient reactivation process. For saturated desiccant, a minimum air flow of between 5-10 cubic feet per minute at 100°F is required.

Conclusion

The process of reactivation requires the application and achievement of a number of simple controls for optimum efficiency.

By following and adopting the above reactivation practice and procedures we are confident you will record improvements for the maintenance time and performance of the silica gel.

1005 Desiccant Reactivator Unit

Please contact our Technical Support Division at 1-800-995-5590 or (520) 881-2130 for further information and guidance if required.



Desiccant Reactivation Unit

The Series 2 **Desiccant Reactivation Unit** is a device specifically designed for the regeneration of silica gel.

Simplicity and efficient operation are the key features of the Series 2 **Desiccant Reactivation Unit** with its ability to process up to 55 lbs. (25 kg) of silica gel in a single batch.

The Series 2 **Desiccant Reactivation Unit** is operated from a standard main electricity outlet to power the three kilowatt heaters.

Forced air circulation ensures the evaporating moisture is transported away from the desiccant.

The temperature monitoring and control instruments of the Series 2 **Desiccant Reactivation Unit** are a unique feature and provide precise reactivation management to ensure maximum reactivation efficiency.

The input reactivation temperature control is user settable and includes a constant readout of the inlet temperature.

An accurately located output temperature monitor indicates the progress of the reactivation process through the desiccant bed.

When the output temperature nears the inlet temperature, effective reactivation is complete.

The Series 2 **Desiccant Reactivation Unit** is mounted on wheeled casters for easy placement in a workshop or on site.

The inner desiccant holder is removable for emptying and loading the silica gel.

The Series 2 **Desiccant Reactivation Unit**, when fully loaded with saturated silica gel, drives off more than 4,500 cubic centimeters (4.5 liters) of water vapor during processing in a time of six hours.

1005 Reactivator Unit

Specifications:

Maximum Silica Gel Capacity	55 lbs. (25 kg)
Electrical Supply	240 Volts 60 Hz 3 Kilowatts
Maximum Reactivation Temperature	221°F (105°C)
Reactivation Air Flow (Typical)	7.06 CFM (200 liters/minute)
Elapsed Time Indicator	Event and total hours run
Color and Construction	Gray painted mild steel
Weight	165 lbs. (75 kg)
Dimensions	41.5 in. (1,055 mm) high 20 in. (508 mm) deep 26 in. (660 mm) wide

