Drierite

How Much?

Packaging Suggestions A commonly used storage container is a corrugated carton or a wooden box. Unless they are wax-coated or resin-treated, water vapor is transmitted through them quite readily. Standard practice is to line them with a plastic film, such as polyethylene. While the plastic film will hold liquid water, water vapor may pass through it. For instance, 1-mil polyethylene will pass water vapor at the rate of 1.5 grams/sq. ft./ 24 hrs, while 4-mil polyethylene will only pass about 0.05 grams/sq. ft./24 hrs at 75° F and 100% RH. We normally recommend that you use a minimum of 4-mil polyethylene, or something equivalent to it in water vapor transmission rate.
For short term storage - two to four weeks - we suggest that you use eight ounces of DRIERITE for every 20 sq. ft. of 4-mil polyethylene, plus sufficient DRIERITE to remove the water in the contents of the bag or container. For medium term storage - one to three months - use eight ounces for each 10 sq. ft. of vapor barrier. For long term storage - three months or longer - use eight ounces of DRIERITE for every five square feet of vapor barrier. Enough extra DRIERITE will have to be added in the last two cases to remove the water in the contents of the container. The quantities of DRIERITE recommended above are based on relatively stable storage conditions. If there are large daily fluctuations in temperature or if extremely high temperatures and high humidity are to be encountered, the amount of DRIERITE should be doubled.

How Much DRIERITE Is Required?

There are four sources of water contamination in a closed container or package: the water vapor in the air inside the package, the water adsorbed in the materials inside the package, the water adsorbed on the walls of the container, and the permeation of water vapor into the container. In order to protect the contents of a container or package from the destructive effects of water, enough DRIERITE must be used to remove all the water from these sources.
A hermetically sealed container, closed in a normal ambient atmosphere, would require approximately four ounces of DRIERITE for every 10 cubic feet of free volume to dry the air in the container. At more extreme conditions (100° F and 100% R.H.) eight ounces of DRIERITE would be required. Anything in the container that has water adsorbed in it would require extra DRIERITE. Wood and paper products can have as much as 10% by weight adsorbed water. Styrofoam and some rubber products may have as little as 0.5% adsorbed water. Once the amount of water in the material in the container has been estimated, you can calculate the amount of extra DRIERITE required by dividing the weight of the adsorbed water by 0.06. The total amount of DRIERITE required to protect a hermetically sealed container would be the sum of the amount of DRIERITE required to dry the air volume plus the amount of DRIERITE required to dry the materials in the container.
If a well-sealed container, such as a 55 gallon drum with a gasketed lid, is being used, the amount of DRIERITE required is calculated the same as for a hermetically sealed container, except that an additional four ounces of DRIERITE per ten cubic feet of volume is used to compensate for moisture permeation through the seal. To protect an enclosure such as a safe, tool box or a slip cover can, where there is no gasket, requires about eight ounces of DRIERITE per five cubic feet of volume plus the DRIERITE required to remove the water from the contents of the enclosure. The quantities of DRIERITE suggested above are predicated on the assumption that the ambient storage conditions are rather stable, and there are not large

temperature fluctuations daily. If an unsealed container were stored in a area where the temperature could fluctuate 30° F daily, the container may possibly breathe 200% of its free volume per month. If this were the case, additional DRIERITE would be needed to absorb the water entering due to the breathing of the container.

Liquid Phase Drying of Organic Liquids

Purpose

The following suggestions may serve as general guidelines for the design and operation of pilot plant or production drying of a variety of hydrocarbons and mixed solvents.

Application

In general, the water content of the liquid to be dried should be 1% or less and preferably 0.1% (1000 ppm) by weight. In this range, the DRIERITE can be considered to be economically feasible as a disposable desiccant and is discarded after a single batch use. Alternate procedures include removal of DRIERITE for regeneration or regeneration in place when the equipment is designed for this purpose.

Liquid Properties Affecting Drying

The viscosity, polarity and solubility of water in the organic liquid will determine how difficult the particular organic liquid is to dry. Alcohols, ketones, and amines are more difficult to dry than ethers and aliphatics. Oils and highly branched molecules are more difficult to dry than short or straight molecules. With highly polar liquids, the desiccant must overcome the attraction of the organic molecule. With highly viscous liquids, the water molecule must “find its way" through the liquid to the desiccant. In both cases the liquid must be in contact with the desiccant long enough for the desiccant to absorb the water. With DRIERITE, compounds like liquid propane and butane may be dried with a contact time of less than one minute. Oils and plasticizers may require a 10 or 15 minute contact time. Chlorinated solvents may be dried with 2 or 3 minute contact times, while alcohols, ketones and amines may require 5 or 10 minutes.

Determination of Size

The quantity of DRIERITE necessary to dry a particular batch of liquid must be sufficient to absorb all of the water available as determined by a sample analysis. DRIERITE has a theoretical chemical capacity for water of 6.6%; however, in liquid phase drying, we recommend that 5% be used as a design capacity for the entire column. In other words, 100 pounds of DRIERITE should be used for each 5 pounds of water to be absorbed.
In addition to the above consideration, the size of the drying column or desiccant bed may have to be determined by the flow rate of the liquid to be dried if this flow cannot be adjusted.
Since residence time or contact time between the active desiccant and the liquid is very important, enough DRIERITE must be provided to dry a given flow. Residence time for efficient drying will vary widely depending on the properties of the organic liquid; however, we have found that 3 to 10 minutes should be designed into the operation, if possible, even though contact times of less than a minute have proven successful for some liquids.

The bulk density of 8 and 6 mesh DRIERITE is about 65 pounds per cubic foot, and the granules will occupy roughly 50% of the desiccant bed volume. This has the effect of reducing the residence time to half that of the empty drying column. A liquid flow of one gallon per minute would, therefore, require a desiccant bed volume of 6 gallons (.8 cubic feet) to provide a residence time of 3 minutes. Since this example would require approximately 50 pounds of DRIERITE, it can be stated that for every gallon per minute of flow rate you need at least 50 pounds of desiccant and, perhaps, 100 pounds if a contact time of 6 minutes were desired.

When the two requirements of water absorption capacity and residence time have been met, the quantity of DRIERITE will determine the size of the drying tower.

Drying Column Design

A tall, small diameter column will give maximum turbulence and, perhaps, improve drying efficiency; however, for convenience in filling and emptying the column with DRIERITE, a height to diameter ratio of 4:1 is good, but this could vary from 1:1 up to 8:1. A total height in excess of 7 feet should be avoided to minimize weight on the granules on the desiccant screen support. A 10 mesh or 20 mesh stainless steel screen backed up by a perforated plate (3/8" holes) makes a good support near the bottom of the tower. The flow in the vertical tower can be in either direction once the unit is filled with liquid. The initial filling with liquid must be done from the bottom, creating an upward flow that will not cause channeling through the granules that occurs from top filling. Driers can be scaled to required size to fit any application. It is necessary to have a drain at the bottom to facilitate removal of liquid before changing desiccant and also a good filter on the outlet pipe line to remove suspended particles of desiccant carried over in the liquid stream. In some cases this filter must be in the 1 to 10 micron range to remove minute particles to meet particular specifications. Since the DRIERITE suspension includes absorbed water, this could cause a moisture determination to show incomplete drying.

Operation

Placing the DRIERITE granules in the column should be done carefully by building up uniform layers of granules. Just pouring them into the center of the vessel will cause a cone shaped pile of segregated granules with larger granules on the periphery, causing channeling or non-uniform flow through the drier.

The pressure and flow of the liquid should be regulated to avoid surges that might cause DRIERITE granules to be carried out the outlet pipe. Sometimes a holddown screen on the top of the desiccant bed is necessary. Normally, the flow rate is slow enough that pressure drop in the column is negligible.

After the batch of liquid has passed upward through the column, the liquid remaining in the drier should be drained out and considered not to be dry, because it has not passed through the entire column and, at this point, the desiccant is probably exhausted or saturated with water.

If the results of a final moisture determination on the liquid are not satisfactory, the flow rate and the total quantity of liquid to be dried may have to be decreased until the appropriate degree of dryness is attained. When the drier is used on a tank of liquid in a closed cycle where the liquid is pumped through the drier and back into the tank, the flow may be circulated until the moisture in the entire system gradually drops to the desired level.

Regeneration

DRIERITE can be reused by regenerating it after it is exhausted. This can be done by removing it from the column and heating it in an oven or it can be reactivated in the column. If the DRIERITE is removed from the column it should be placed in pans or trays about one inch deep and heated at 400° to 450° F for two hours. It is recommended that the organic liquid be vacuumed off before the DRIERITE is removed from the column. This will make it easier to handle the DRIERITE and reduce any hazards as far as the organic liquid is concerned. If there are any impurities or resinous materials in the liquid that may be adsorbed on the DRIERITE and char or decompose at regeneration temperatures, the DRIERITE should be regenerated under vacuum. With 26" Hg vacuum, the DRIERITE can be regenerated at 325° F and at 28" Hg at 275° F.

The DRIERITE can be regenerated in the column by several methods. Again, it is recommended that the organic liquid be vacuumed off. Once this is done, the DRIERITE can be regenerated with hot air. It requires approximately 25 scfm of air per 100 pounds of DRIERITE heated to 450° F to regenerate the DRIERITE in four hours. The air should pass downward through the DRIERITE. This prevents condensate from dripping down on the DRIERITE. If vacuuming of the liquid is not feasible, an inert gas can be used instead of the air. With an inert gas, a closed loop with a condenser is normally used. This way, the organic liquid in the DRIERITE may be recovered and the inert gas can be reused. If the organic liquid has a high boiling point or decomposes at the regeneration temperature of DRIERITE, it can be regenerated under vacuum at the temperatures and pressures listed above. The drying column and the regeneration piping should be insulated to reduce heat loss during regeneration. The bed should be cooled to ambient temperature as soon as possible after regeneration. This can be accomplished by using cooling coils, dry air or inert gas on a once through basis or in a closed circuit with a heat exchanger.

Drying Air & Gas

Industrial driers have many applications for the drying of air and industrial gases in relatively large quantities on either continuous or intermittent duty cycles. Usually the requirements are such that two columns are needed, one to be in service while the other is being regenerated.

Calculation of Bed Size

Cooling a gas that is to be dried is an economical way to reduce its water load. A gas saturated at 100° F carries approximately three pounds of water per 1000 cubic feet. If this gas is cooled to 78° F, half of its water load is removed by condensation. This is more economical than drying by chemical means alone.

The size of a DRIERITE bed is usually calculated on the basis of the amount of water to be absorbed in the desired operating period. The water load is determined by the volume, temperature, pressure, and degree of saturation of the gas to be dried. Commercial grade DRIERITE has a design capacity of 5% and Du-Cal has a design capacity of 10% under most conditions. DRIERITE weighs approximately 65 pounds per cubic foot. From these constants, the weight and the volume in cubic feet of the desiccant are calculated. The pressure and the allowable resistance to flow through the desiccant bed are considered in determining the diameter and depth of the bed and the granule size of the desiccant.

In cases where the gas to be dried has a low water content and the volume of the gas is large, the rate of flow becomes the basis for the calculation of the quantity of desiccant and the size and the dimensions of the columns. The size of the unit in this type of application is larger in order to allow sufficient contact time of the gas with the DRIERITE. One pound of DRIERITE should be used for each 10 cubic feet per hour of actual flow rate for maximum efficiency.

Packing DRIERITE Beds

In placing the DRIERITE in the columns, care should be taken to obtain uniform distribution over the whole cross-section to avoid channeling. Pouring in from the top allows larger granules to roll out from the center and makes channeling probable. The desiccant should be lowered into the column in small containers or using a suitable funnel arrangement.

Regeneration of DRIERITE in Columns

Regeneration is usually accomplished by passing hot air through the drying column. A blower forces air through a heater where it is heated to 450° F and then downward through the DRIERITE bed. The moisture laden air is exhausted to the atmosphere. When a thermometer located in the bottom of the DRIERITE bed reads approximately 400° F, the regeneration is complete. The heat is turned off and the blower should continue until the top of the bed has cooled to about 274° F and then turned off to prevent absorption of moisture. When the bed has cooled to operating temperature, the column may be returned to service.

Approximately 250 to 300 BTU's are required to regenerate a pound of DRIERITE exclusive of heat loss. Any source of heat may be used that will provide clean air for the operation at the required temperature. If the tower has two inches of insulation, it will require about 25 scfm of air and 3 KW's of electric heat per 100 pounds of DRIERITE to regenerate it in four hours. The accumulation of dust, soot, resinous materials, etc., which may clog the pores of the granules, will bring about the gradual deterioration of the DRIERITE.

Regeneration of Drierite Desiccants

After normal use, any of the forms of DRIERITE may be regenerated for reuse. The operation is simple and involves only standard equipment. The used and exhausted desiccant should be ventilated to remove vapors, if any, and stored in a convenient container until a sufficient amount is accumulated to justify the work of regeneration.

Regular and Indicating DRIERITE

For the regeneration of Indicating DRIERITE and small lots of Regular DRIERITE , the granules may be spread in layers one granule deep and heated for 1 hour at 210° C or 425° F. The regenerated material should be placed in the the original glass or metal container and sealed while hot. The color of the Indicating DRIERITE may become less distinct on successive regenerations due to the migration of the indicator into the interior of the granule and sublimation of the indicator.

Commercial Grade and Du-Cal DRIERITE

Exhausted Commercial DRIERITE or Du-Cal DRIERITE should be spread about 1 inch deep in shallow pans and heated in a oven at 450° F or 230° C for 2 hours to achieve complete dehydration. The regenerated material should be placed in the original container and sealed while hot.

The Importance of Temperature

The temperature at which DRIERITE desiccants are regenerated is crucial in restoring DRIERITE to its original condition. Absorbed moisture is water of hydration and is chemically bound to the calcium sulfate of DRIERITE. Temperatures in the range of 400° - 450° F are required to break these bonds and release absorbed moisture. Lower temperatures, regardless of heating time, will not regenerate DRIERITE unless applied under vacuum (26" Hg, 325° F or 28" Hg, 275° F). Care should be taken not to overheat DRIERITE Desiccants. High temperatures can alter the crystal structure and render the desiccants permanently inactive.

All information provided here is from Drierite