Hurricane Response Seminar

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Topics

- Why Use Desiccants
- Role Of The Engineer
- Wood Facts
- psychometrics
- Environmental Drying
- Water Damage Restoration Drying Equipment
- What Is A Desiccant
- Why Use Desiccants
- Concrete Drying
- Contractor Selection
- Questions

Why Use Desiccants?

- Cost Savings
- Reduced Repair Costs
- Less Power Consumption
- Fewer Electrical Circuits Required
- Removes More Moisture Refrigerant Dehumidifiers
- Minimizes Business Loss (aggressive drying)

Role of the Engineer (JPC)

JPC is engaged by PDT to provide all parties involved in the loss an independent overview of the drying process.

If necessary JPC can provide engineered (sealed) documents to submit for building permits associated with the reconstruction.

How do engineers come into play in disaster restoration?

Qualified engineers consider the variables and evaluate the technicians drying equipment quantity and placement or in the case of desiccant drying the air quantity being delivered to the various wetted areas.

Monitor the daily logs.

Ensure the work is being managed in compliance with concensus industry standards.

At the end of the drying process if all the appropriate & necessary actions are taken and the building/structure is dry to pre-loss moisture content I will so certify with my Florida engineers seal.

In addition to the drying activity I observe and advise owner representatives of conditions that may require redesign subsequent to drying to ensure the mechanical, electrical, plumbing and building envelope systems do not compromise the success of the drying/restoration process.

Forensic evaluation of causation location is an extremely valuable asset to owners, remediators and insurance adjusters. Old microbial defacement damage may be a covered loss if reconstruction requires the old damaged area to be removed to facilitate rebuild.

Wood Facts

- Mold on framing is generally surface mold and can readily be removed by washing and only stain will remain.
- Wood will begin to decay at 28% moisture content and will stop at 20% (consensus)
- The more processing (cooking) the wood product has had the more prone it is to be “mold candy”.

- Overall the water permeability of building envelopes has changed
- Rate of wetting greater than rate of drying and the structures ability to accumulate water results in mold
- Water will penetrate all claddings
- Current construction techniques and wet materials will result in about 20% of all wood buildings developing a mold problem

psychometrics

Psychrometry is the science and practice associated with atmospheric air mixtures, their evaluation, control and affect on materials and occupant health and comfort. Drying effectiveness is determined by four factors: temperature, humidity, air movement and time. Managing the relationship between these factors is critical. It is highly recommended that restoration technicians understand the principles of psychrometry.

Understanding these relationships can assist in the management of the drying system; where humidity is removed from the air as fast or faster than it is created by evaporation. Moreover, it helps technicians dry and restore structural materials and contents that otherwise might require demolition or disposal.

A thorough understanding of the following information is needed to apply the principles of psychrometry:

TEMPERATURE

Temperature refers to the standard or common temperature that is obtained by using a dry-bulb thermometer. Knowledge if the temperature, during drying is important for at least these reasons.

HUMIDITY

- Humidity: Temperature has a direct effect on relative humidity. As temperature increases, the moisture holding capacity of air increases, and since the actual moisture in the air remains the same, the relative humidity (RH) decreases. Lower RH promotes evaporation. Higher RH not only slows evaporation, but it can result in increased secondary damage.

- Microorganism Growth and Health: Temperature has an effect on the formation of some microorganisms, along with odor and the potential for increased damage to materials on which they grow.

RELATIVE HUMIDITY (RH)

A hygrometer should be used to obtain and record relative humidity (RH) readings. Knowledge of the RH is important for:

- Drying Efficiency: Generally, the lower the RH the faster and more efficient the drying process. After initial extraction of standing water, establish a relationship between evaporation and dehumidification that promotes efficient drying. A target ambient RH of <40% is recommended for optimum drying.

SPECIFIC HUMIDITY

Once temperature and RH are known, specific humidity (weight if moisture in the air) can be determined. Specific humidity provides a more reliable basis for making decisions about the drying process rather than those based upon RH.

VAPOR PRESSURE

Once temperature and RH are known, vapor pressure (the force exerted by water vapor on surrounding surfaces) can be determined. Moisture seeks a level of equilibrium with the surrounding environment. The lower the vapor pressure within a room, the faster structure and contents materials, adjacent space, and otherwise inaccessible areas, will dry. Since specific humidity and vapor pressure are directly related, calculation of specific humidity can be used to make decisions regarding vapor pressure.

RELATED FACTORS AFFECTING THE DRYING PROCESS

It is highly recommended that technicians consider several other factors that may enhance the drying process. These may include, but are not necessarily limited to:

- Evaporation: Promote evaporation using sufficient quantities and types of air moving equipment. Evaporation is greatly improved by the velocity of air movement.

- Dehumidification: Dehumidification is required to remove excess moisture from the air as a result of evaporation. In a closed drying system, proper types and sufficient number of dehumidifiers must be employed to ensure moisture removal from air at a rate that is equal to or greater than the rate of evaporation.

- Hygroscopic Materials: Hygroscopic materials are those that readily absorb or attract moisture or water vapor. Most hygroscopic structural materials are designed for use in environments with humidity levels between 30-60% RH. The degree to which hygroscopic materials will absorb moisture depends on the material's porosity.

- Porosity and Permeance: Porous materials have pores or holes capable of allowing liquids or gases to permeate or pass through. Permeance is a measure of water flow through material(s) of specific thickness. Permeance factors (perms) specify the vapor flow in grains of moisture per hour, through one square foot of material surface, at one inch of mercury (1” Hg) of vapor pressure. Generally, the porosity of a material is based on its permeance factor and is evaluated as follows:

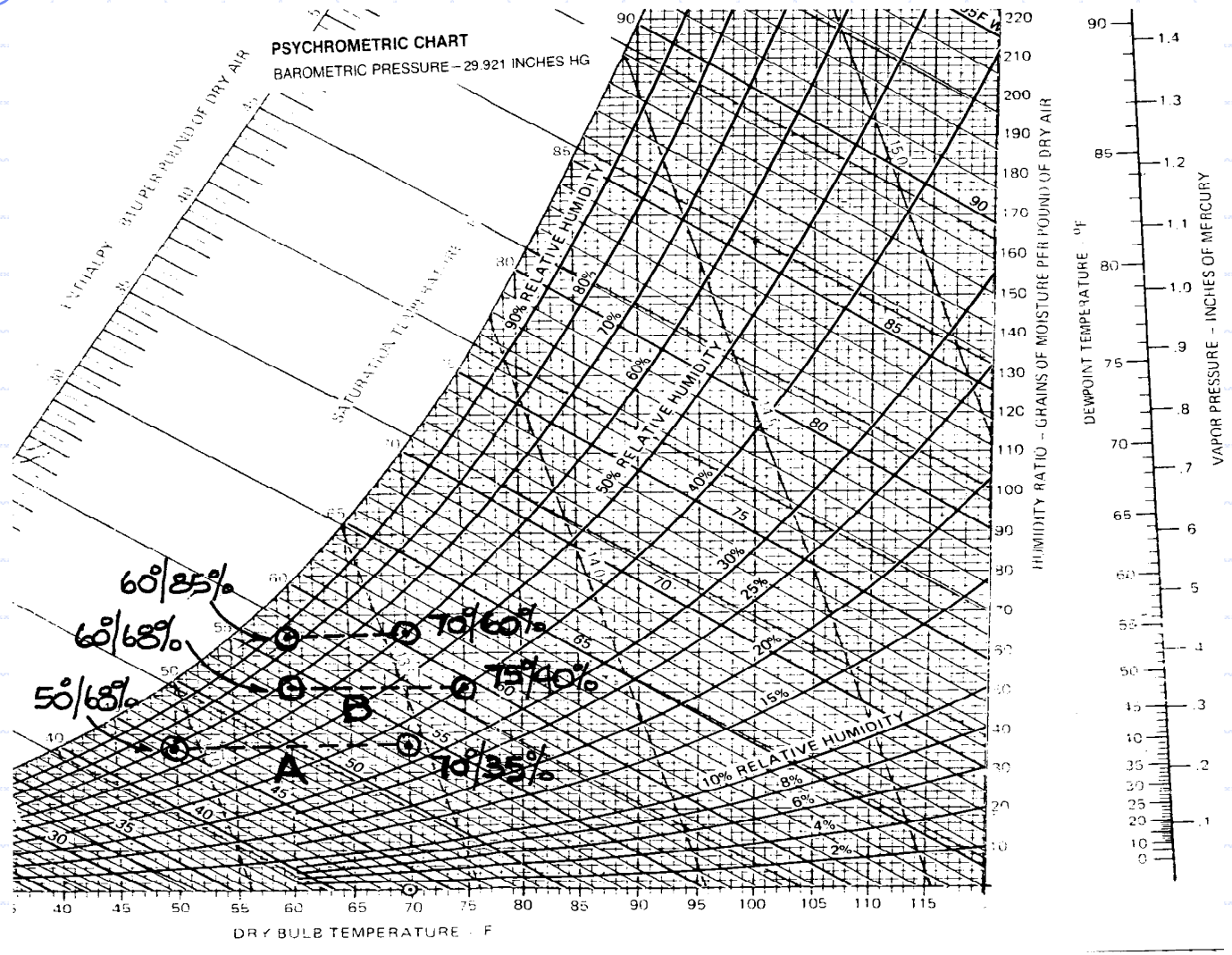
- Highly porous (permeance factor >10): These materials may include, but are not necessarily limited to: carpet, carpet cushion, mattresses and box springs, stuffed upholstered furniture, cardboard, tackless strips, wicker and straw.
- Semi-porous (permeance factor of >1 to 10): These materials include items such as linoleum, vinyl wall coverings, vinyl upholstery and hardboard furniture, as well as construction materials like most wood, painted drywall and plaster.

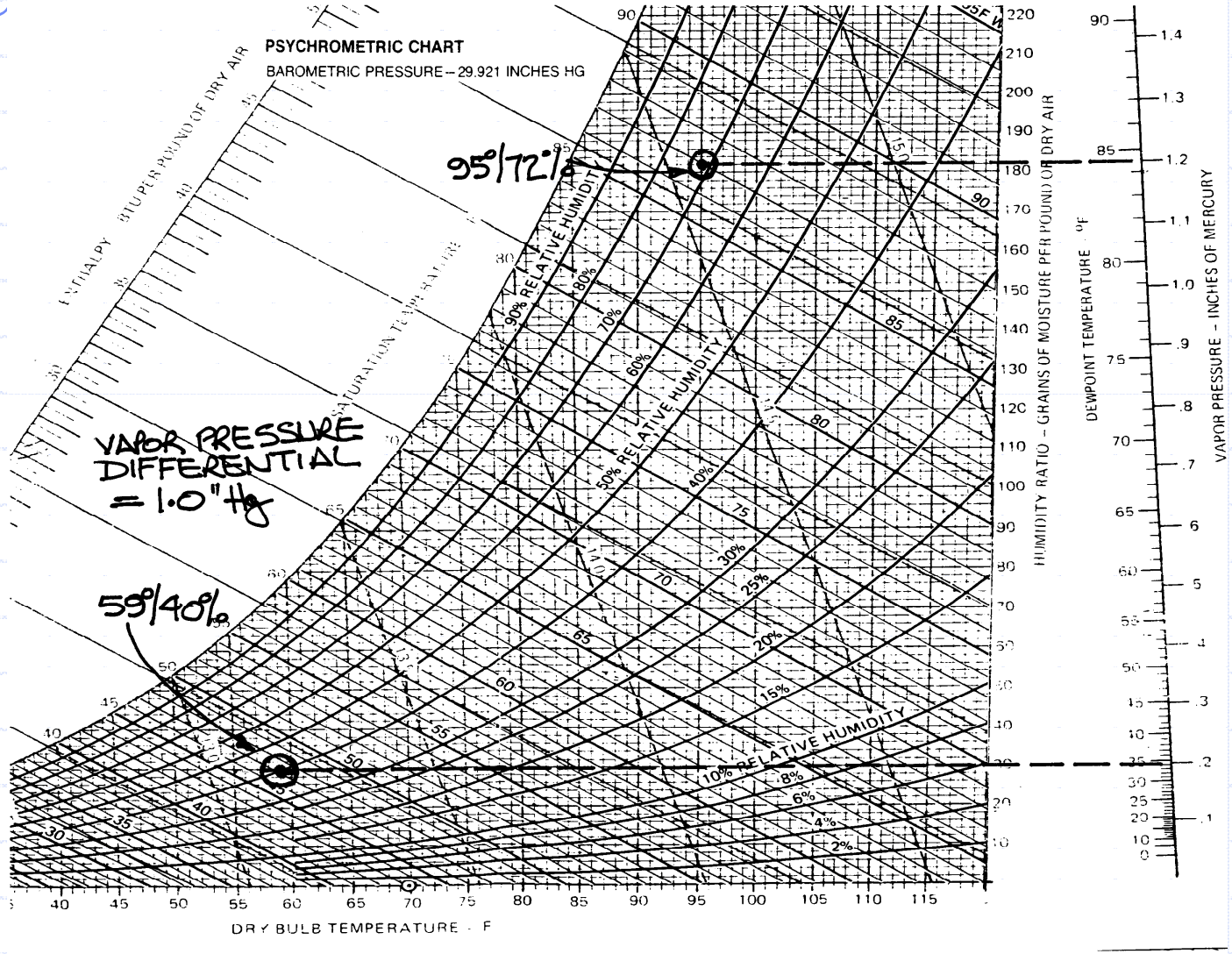
- Nonporous (permeance factor <1): These materials include Formica®, vinyl, plastic, glass, tile finishing materials, and many other durable materials or materials sealed with durable finishes.

RECORD KEEPING

Daily records documenting temperature, relative humidity and specific humidity, in conjunction with material moisture content measurements, are mandatory. This documentation clearly demonstrates drying progress. In addition, this promotes a better understanding of the drying process for all parties to the loss, while reducing liability and increasing credibility for the restoration company involved.

Psychometrics




PSYCHROMETRIC CHART
BAROMETRIC PRESSURE – 29.921 INCHES HG
95/72%
VAPOR PRESSURE DIFFERENTIAL = 1.0" Hg
59/40%
ENTHALPY - BTU PER POUND OF DRY AIR
SATURATION TEMPERATURE - F
90% RELATIVE HUMIDITY
80%
70%
60%
50% RELATIVE HUMIDITY
40%
30%
25%
20%
15%
10% RELATIVE HUMIDITY
8%
6%
4%
2%
HUMIDITY RATIO – GRAINS OF MOISTURE PER POUND OF DRY AIR
DEWPOINT TEMPERATURE - °F
VAPOR PRESSURE – INCHES OF MERCURY
DRY BULB TEMPERATURE - F

Environmental Drying

The process of drying out the building envelope while taking into consideration the occupant's indoor air quality before, during and after the drying process.

HOW MUCH EQUIPMENT IS NEEDED?

Consider:

- What is the cubic footage of the building?
- A practical goal is two to three air changes of dehumidified air per hour.

Variables:

- Source of the water.
- Outside conditions-high relative humidity to overcome. (25% more time in a hot/wet climate)
- The insured's issues with equipment staging and placement.

HOW LONG WILL IT TAKE TO DRY?

It depends:

- Outside conditions
- Age of building
- Type of construction
- Is the roof on?
- Can containment be built?
- How long was it wet? (capillary action)

WHAT WAS THE SOURCE OF THE WATER?

- Hot Water Heater that lost 1000 gallons of water.
- Sprinkler Head that released 120gpm (gallons per minute) that ran for 8 hours.
- The Fire Department that pumped water under 200psi (pounds per sq. inch) for untold time.
- River Water that flowed through the building and took a week to recede.
- Hurricane that dumped unknown quantities of water on the building and access to commence drying was restricted.

Water Damage Restoration Drying Equipment

WATER REMOVAL EQUIPMENT AND TOOLS

Extraction equipment is the domain of CSI, Joe will address later.

AIR MOVING EQUIPMENT

Air moving equipment is used to direct airflow at or across wet materials to promote evaporation. Air moving equipment will have various airflow and static pressure capabilities.

- Air movers: Air movers are the most common equipment used in water damage restoration to promote evaporation. Air movers use a squirrel cage fan and, generally, the air is directed through a snout. Air movers create a laminar air flow to assist in surface and sub-surface drying.

- Air Filtration Devices: A portable air moving device equipped with HEPA or carbon filtration. It can be used to filter air while negative pressure in contaminated areas as a "air scrubber," removing airborne contaminants without changing pressure.
- Structural Cavity Drying Equipment: Various accessories can be attached to airmoving equipment to manipulate airflow to materials and enhance the drying process. This process may enhance the drying process, if applied correctly.

DEHUMIDIFIERS

Dehumidification is essential in removing evaporated moisture from air to minimize or prevent secondary damage. In closed drying situations, mechanical dehumidifiers of sufficient capacity are necessary to create an effective drying system, ideally within 24 hours of the inception of drying. Generally, there are two categories of dehumidifiers: refrigerant and desiccant.

- Refrigerant dehumidifiers: Refrigerant dehumidifiers work on the principle of condensation. Refrigerant dehumidifiers work most efficiently above 68ºF (20ºC) and/or 40% RH (>40gpp). Below 68ºF (20ºC) and/or 40% RH (<40gpp) refrigerant dehumidifiers may cool moisture in the air being processed below the frost point resulting in icing on the evaporation coils. Some refrigerant dehumidifiers that have defrost systems and may be more appropriate for use in conditions where the air may be cooled below the frost point.

- Desiccant dehumidifiers: Desiccant dehumidifiers work primarily on the principle of adsorption. As a result, desiccant dehumidifiers are efficient across a broader range of atmospheric conditions than are refrigerant dehumidifiers. Desiccant dehumidifiers do not cool the air, and therefore, icing is not an issue.

Structural Drying

There are three critical elements to effective structural drying:

1. Extraction – a great job is required; it is 1200 times more efficient then evaporation (about 30gpm)
2. Evaporation – as much as possible
3. Dehumidification – as much as necessary for all the evaporation (at best 30 gal/day)

A thorough physical extraction will decrease the amount of time necessary to bring the structure to a pre-loss moisture content.

CLASSIFICATION OF EVAPORATION

The classification of evaporation will be determined by the type and amount of wet material determined as salvageable.

Class 1 – Slow rate of evaporation; losses with low-permeance/porosity materials. Little or no wet carpet/cushion is present.

Class 2 – Fast rate of evaporation; losses that effect the entire room of carpet and cushion and or water has wicked up walls less than 24 inches. There is moisture remaining in structural materials.

Class 3 – Fastest rate of evaporation; carpet and pad with water from above or water more than 24 inches up walls. Virtually the entire area is saturated.

Class 4 – Specialty drying situations focus on bound water.

These losses involve materials with very low permeance/porosity.

DEHUMIDIFICATION EQUIPMENT REQUIREMENT

Air Movers Quantity:

Class 1 – ensure air movement across all wet surfaces. May require as few as 1/300 square feet (SF) to 1/150 SF

Class 2 – 1/50 SF to 1/60SF

Class 3 – 1/50 SF to 1/60 SF

Regardless of class, ensure air movement across all wet surfaces. This may require an air mover for every bay window, closet or offset.

Air Mover Installation

- Clockwise rotation at 45º angle – touching wall
- Inlet towards wall
- Turbulence – circular air flow
- Installation criteria – one for every 10-14 lineal feet of wall (JPC typically recommends maximum of 12 feet).

Dehumidifier Quantity (for both refrigerants and desiccants)

1. Determine the cubic feet of the affected area. Provide containment as necessary to separate wet and dry areas.
2. Determine type of dehumidifier
   - Standard or conventional refrigerant
   - LGR (low grain refrigerant) which has preheat or defrost (hot gas-bypass) to eliminate coil icing.
   - Desiccant Dehumidifiers

3. Determine the class of water loss.

4. Do the Math.

Class	1	2	3	Use
Refrigerant	1/100	1/40	1/30	Pints
LGR	1/100	1/50	1/40	Pints
Desiccant	1	2	3	ACH

You must know the AHAM (Association of Home Appliance Manufacturers) water removal rate of the refrigerant dehumidifiers at a condition of 80ºdb/60% relative humidity for 24 hours (given in pints/day).

This is the starting calculation only and must be adjusted & as job conditions change by evaluating the psychometric conditions.

$$\frac{\text{cubic feet}}{\text{flow chart value}} = \text{AHAM pints necessary}$$

The process air flow cfm (cubic feet per minute) necessary using desiccant dehumidifiers is:

(ACH) air changes per hour (flow chart value) x $\frac{\text{cubic feet}}{60}$

Example: Class 3 loss

20,000 SF, 10 FT. HT. = 200,000CF

LGR: $\frac{200,000}{40}$ = 5,000 pints

No. Req'd: Phoenix 200 @ 133p/d = $\frac{5000}{133}$ = 37.59

Always roundup – 38 req'd; 7.4 amps @ 120 volts.

:DrizAir2400 @ 146 p/d = $\frac{5000}{146}$ = 34.2

35 req'd; 11 amps. @ 120 volts.

Desiccant: $200{,}000 \times \frac{3}{60} = 10{,}000$ cfm

use (2) 5,000 cfm units or (1) 10,000 cfm unit
20 amps at 240 volts each 5000 cfm unit

Power Consumption:

LGR @ 7.4 amps & 120v (19-20A circuit req'd)

$$38 \times 7.4 \times \frac{120}{1000 \text{ W/KW}} \times 24 \text{ H/D} = 810 \text{ KWH/D}$$

LGR @ 11.0 amps $ 120v (35-15A circurts req'd)

$$35 \times 11.0 \times \frac{1200}{1000} \times 24 = 1109 \text{ KWH/D}$$

Dessicant @ 20.2A 240v (1-50A circuit req'd)

$$2 \times 20.2 \times \frac{240}{1000} \times 24 = 233 \text{ KWH/D}$$

Cost Comparison

35-LGR's @ $125.00/D = $4375.00

2-Dessicants @ $1400.00/D = $2800.00

Electrical Cost @ $0.10/KWH:

38-LGR's: 810 x 0.10 = 81.00 $/D

2 Desiccants: 233 x 0.10 = 23.30 $/D

Difference = 57.70 $/D

Daily Cost avoidance:

4375.00 – 2800.00 + 57.70 = 1632.70 $/D

What is a Desiccant?

Mold forms in 48 hours if elevation moisture levels exist as a consequence of structural wetting.

Desiccant materials attract water of the air as a vapor. Humid air has a high vapor pressure. Dry desiccant has a low vapor pressure.

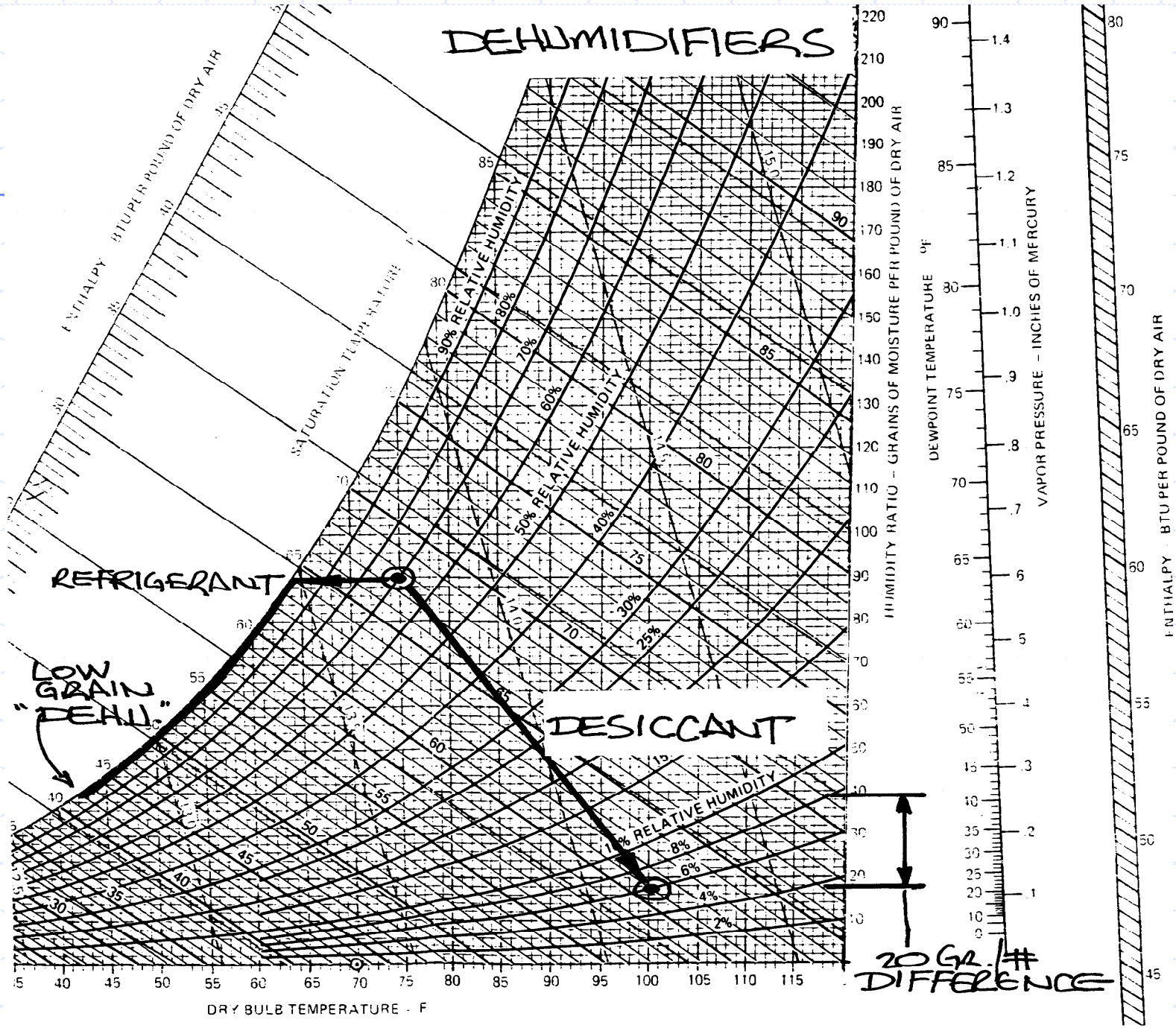
Propelled by this vapor pressure difference, water molecules (as a vapor) move out of the humid air to the desiccant which captures the water molecules onto the surface of the desiccant medium by a process called adsorption.

Solid desiccant materials are adsorbents with a tremendous internal surface area providing for the capacity to handle large volumes of water.

A single gram (less than one teaspoon) of dry desiccant can have more than 50,000 square feet of surface area (equivalent to the size of a football field).

After being loaded with water molecules the desiccant is reactivated (dried out) by heating, which raises the vapor pressure of the material above that of the surrounding air.

Desiccant drying controls mold formation.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Why Use Desiccants

- Cost Savings
- Reduces repair cost
- Less Power Consumption
- Fewer electrical circuits required
- Removes more moisture from the air and the surrounding materials than any other type of dehumidifier
- Minimizes Business Loss
- Asset Recovery

- Document Recovery
- Protects Insured's Environment from Microbial contamination with aggressive drying in all environmental conditions
- Reduces repair cost
- Saves equipment – furniture, inventory & documents
- Can provide pressure differential by floor

Concrete Drying

Typically PDT dries concrete to an internal RH of 40% measured at a depth of 1¼ to 1½ below the surface. Therefore it is essential that concrete floors be tested for moisture – emission and that the emission – rate meet the requirements of the floor covering industry or a surface moisture barrier be used.

The two accepted standards for testing moisture-emission are:

- ASTM E1869-98 "Standard Test Method for Measuring Moisture Vapor Emission of Concrete Subfloor using Anhydrows Calcium Chloride."

- ASTM E1907-98 "Standard Practices for Determining Moisture-Related Acceptability of Concrete Floors to Receive Moisture – Sensitive Finishes.

ASTM = American Society for Testing Materials

If new concrete loses moisture more slowly the longer it cures, how long does it take mature concrete to dry after it's rewetted? To find out, The Swedish Council for Building Research tested well-hydrated concrete specimens more than a year old. After rewetting the mature concrete specimens of different thicknesses and water-cement ratios were allowed to dry at 50% relative humidity and 70ºF. The internal RH was measured at a depth of 40% of the thickness for one-sided drying and 20% of the thickness for two-sided drying.

Rewetted mature concrete with a water-cement ratio of 0.70 and drying from one side took 515 days to reach 85% internal RH. To reach the same RH level, newly placed concretes with the same water-cement ratio took 185 days.

This confirms the experiences of contractors who have had to repair flooded basements. When a basement floods, the mature concrete absorbs water and gives it up at a much slower rate. Removal and replacement of a moisture-sensitive floor covering in a flooded basement will probably require the use of a surface moisture barrier to limit the concrete's moisture-emission rate.

Contractor Selection

You may need a drying contractor to help you mitigate your loss. Reputable contractors would agree that you take the following steps:

1. Check the firms reputation
2. Ask for proof of insurance
3. Ask for references
4. Ask for a written proposal – check to make sure it includes everything you expect the contractor to do.
5. Ask for a contract

6. Ask for the certifications of the technicians who will be assigned to your project
7. Ask if the drying is going to be monitored in compliance with the consensus documents
8. Obtain a copy of the final signed contract
9. Don’t sign off before the job is finished

Areas recuperating from catastrophic wetting are often prime targets for less-than honest business activities. Florida building codes require work be done only by licensed contractors.

Make sure your contractor calls you or a qualified observer (independent third party) to inspect the work before it is covered over.

Questions?

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