

# Who Says Sorbents Cannot Eliminate Flammability ?

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# Who Says Sorbents Cannot Eliminate Flammability ?

- (or suppress hazardous vapors ?)
- Routine ER training warns not to rely on sorbents to reduce harmful/hazardous vapors.
- **Why? Imagine your worst nightmare !!**



■ **THIS WARNING IS GENERALLY VALID !!**



# The ER Person Faces, e.g.,

- Some Risks during Solvent/Fuel/Etc. Spill Cleanups Include:
  - Electronic Switch/Ignition Sparks
  - Cell Phone/PD Device Use
  - Static or Sparks in Course of Cleanup
  - Lab Equipment/Catalytic Converters at High Temperatures
  - Smokers in Vicinity



# What If ?

- **Potential Ignition Situation**

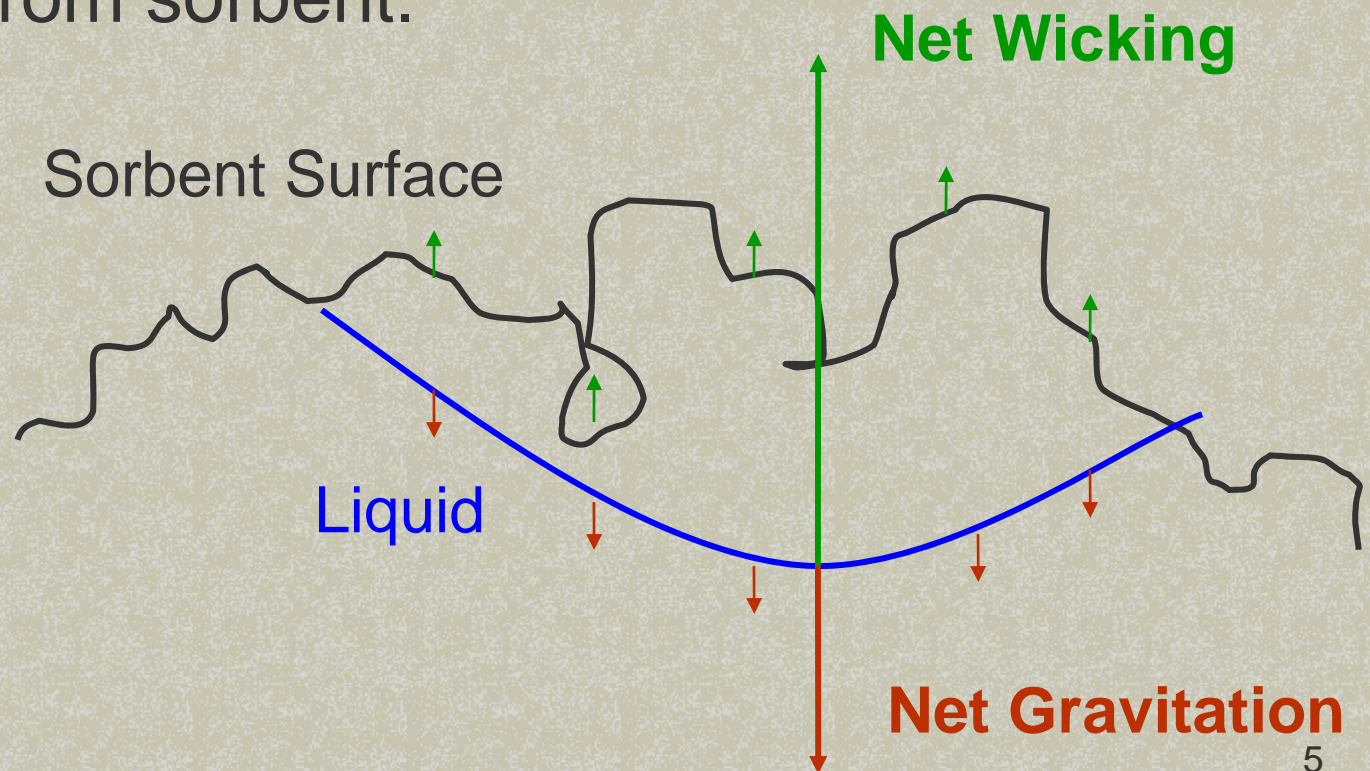
- What if your sorbent DID cut down the flammability of spilled liquid?
  - Less risk of fire or explosion.
  - Less involved disposal procedures.

- **Respiratory Protection Situation**

- What if your sorbent DID cut down vapor level?
  - Decreased need for protection.
  - Less involved disposal procedures.

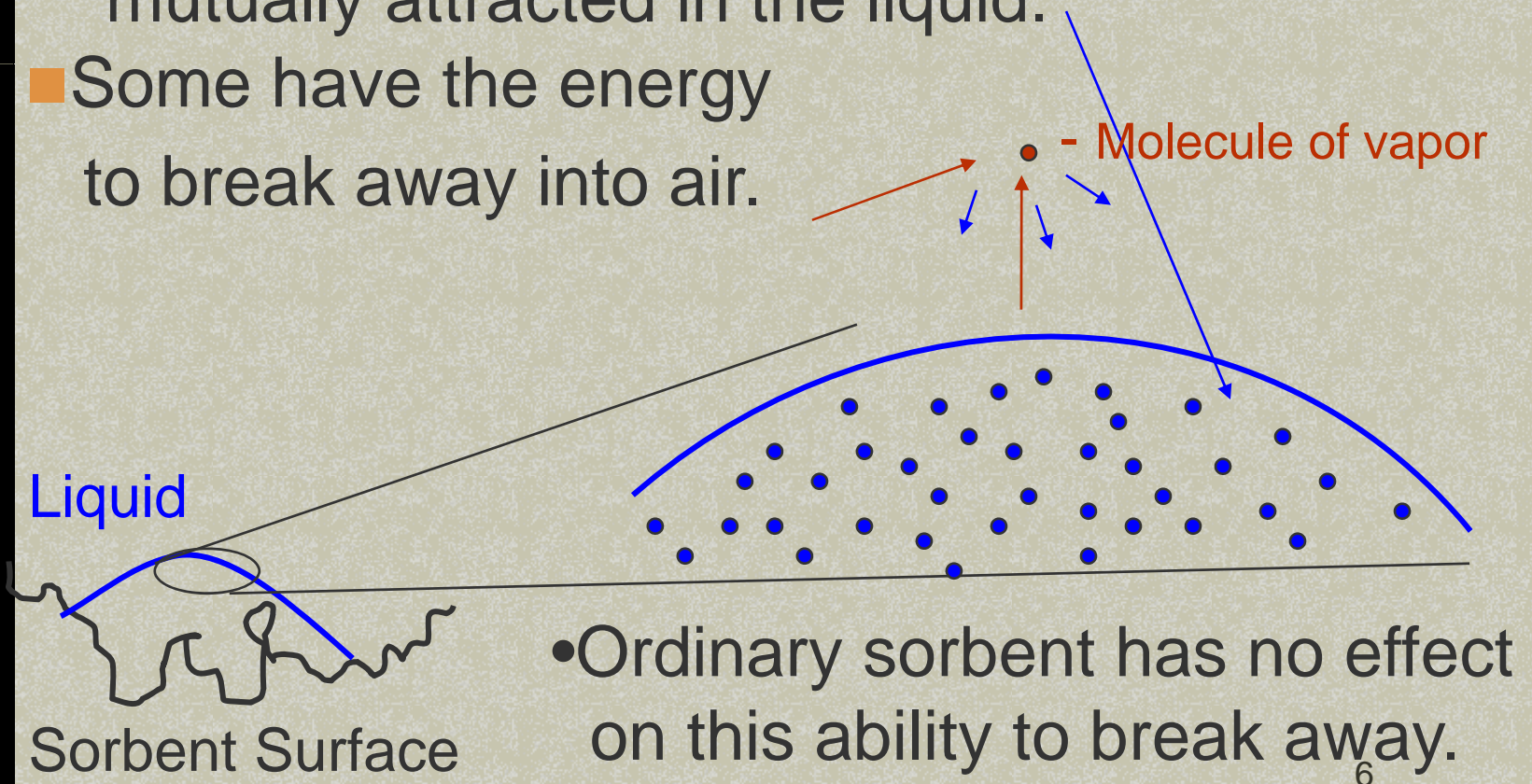
# What is the Basis for the Rule ?

- What is a sorbent ordinarily ? Basically:
  - **Wicking forces** attract liquid to a sorbent.
  - **Force of gravity** attempts to separate liquid from sorbent.



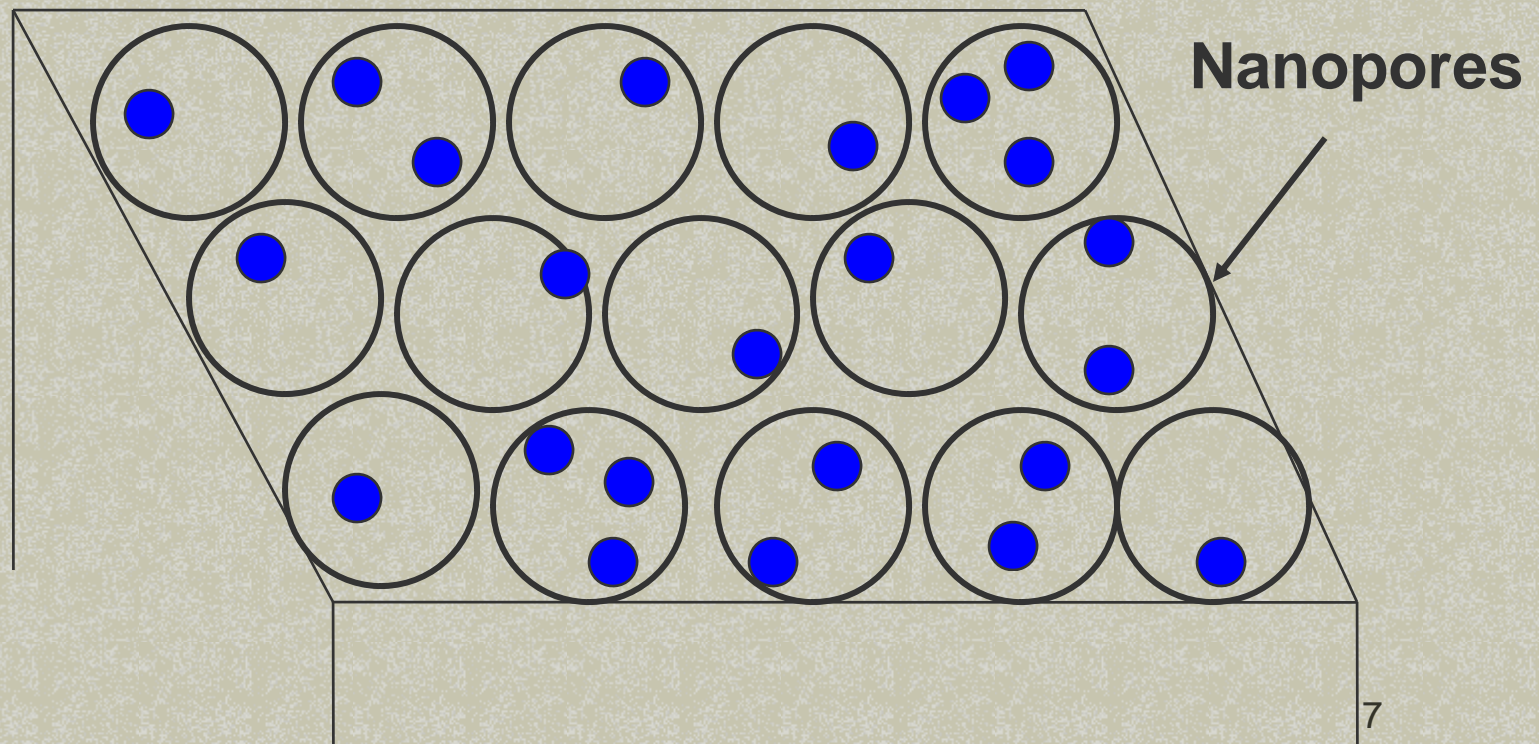
# What Causes Vapor over a Spilled Liquid ?

- Random thermal motions of the molecules mutually attracted in the liquid.
- Some have the energy to break away into air.



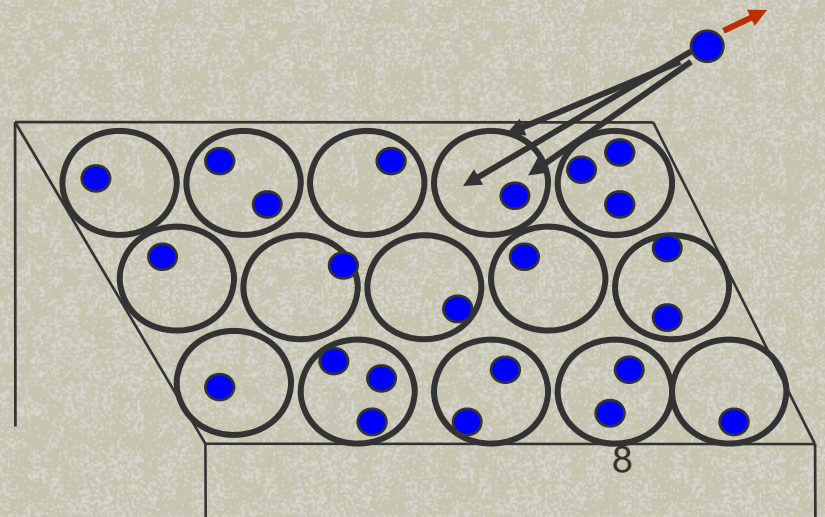
# What Kind of Sorbent is the Exception to this Rule ?

- What if the Fineness of the Porosity is of Molecular Size, i.e. **Nanoporous** ?



# What Kind of Sorbent is the Exception to the Rule ?

- What if the Fineness of the Porosity is of Molecular Size, i.e. **Nanoporous** ?
- AND the spilled liquid molecule attraction to the sorbent is much stronger than to like molecules.
- Such sorbents are not uncommon.



# Zeolite Minerals are Examples

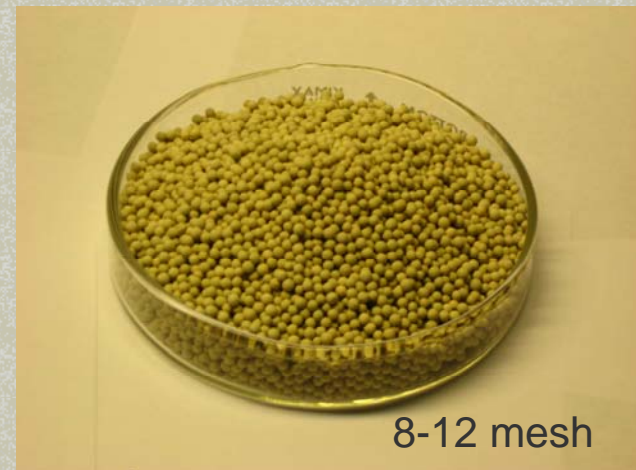
- One variety called a Faujasite zeolite is especially effective & is totally harmless.
  - Other common uses:
    - Use as an “ion exchanger” in water softeners.
    - Use as a chemical molecular size “sieve”.

- Typical forms:

Micron-Size Powder



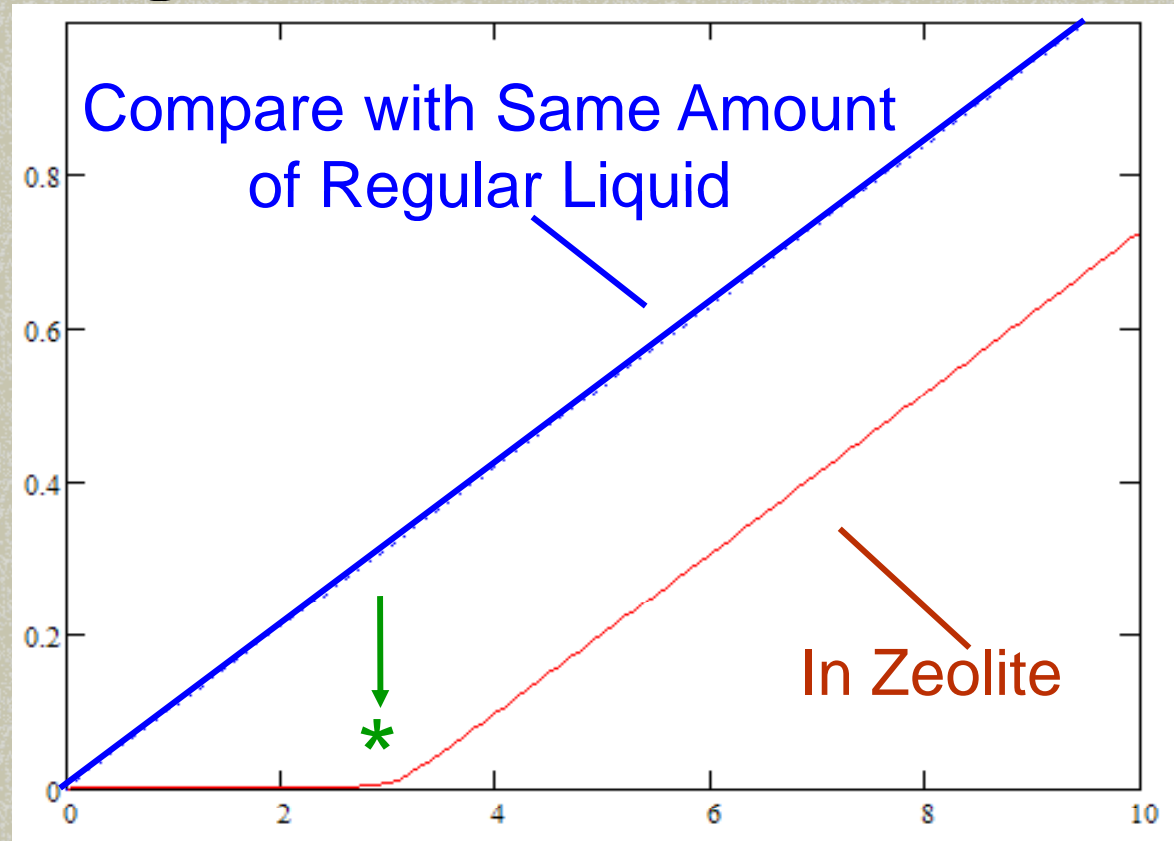
Manufactured Beads  
4-8 or 8-12 Mesh



8-12 mesh

# Filling of the Nanopores

Amount of Regular Liquid

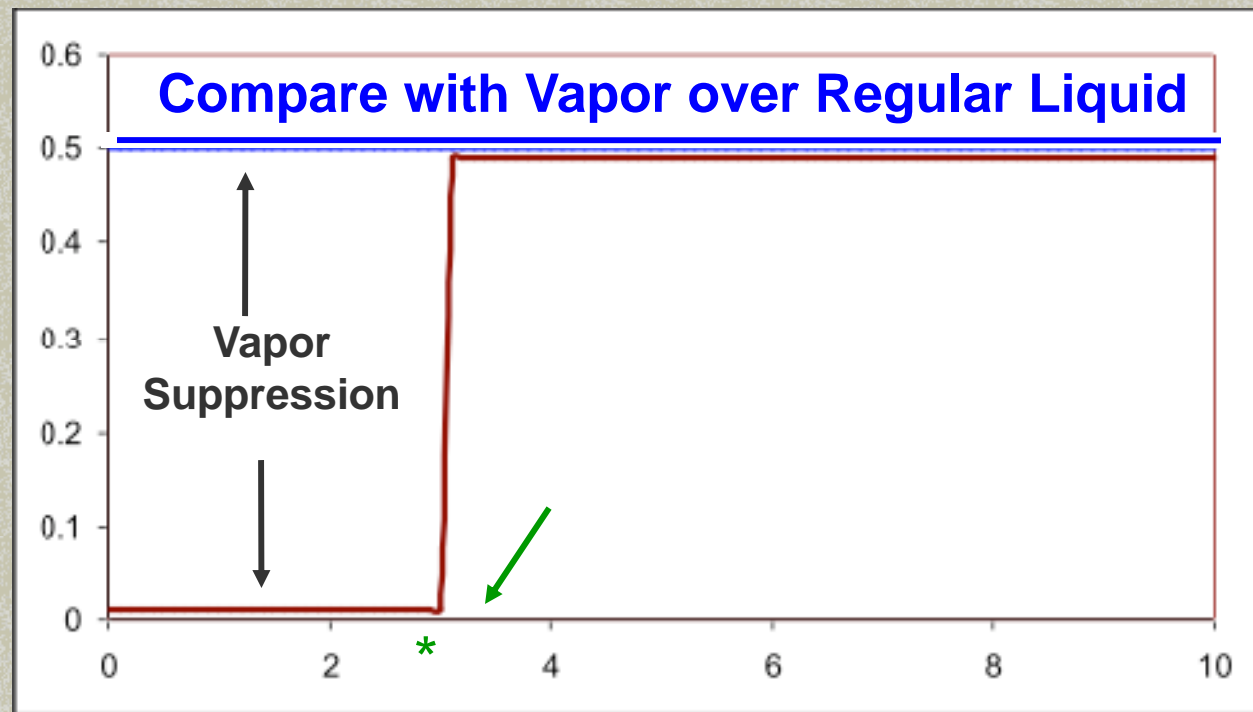


No. of Molecules per Pore

\*Point where pores have filled and regular liquid begins to accumulate around the zeolite particles.

# Vapor Over the Zeolite

Vapor Over the Zeolite

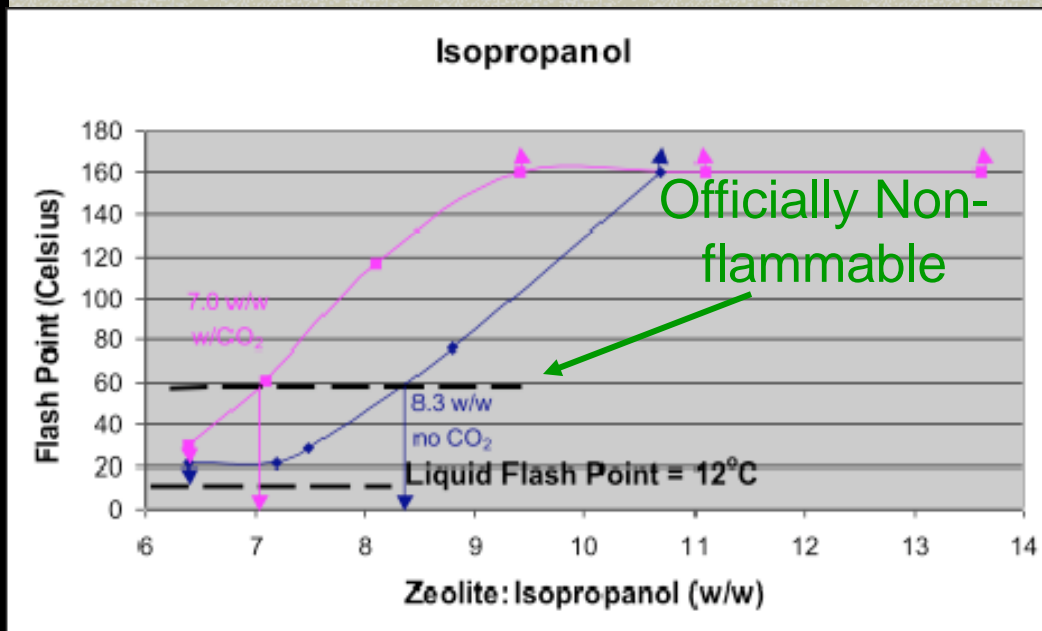


No. of Molecules per Pore

\*Point where pores have filled and regular liquid begins to accumulate around the zeolite particles.

# Does Vapor Suppression Occur? OccurtialAmounts ?

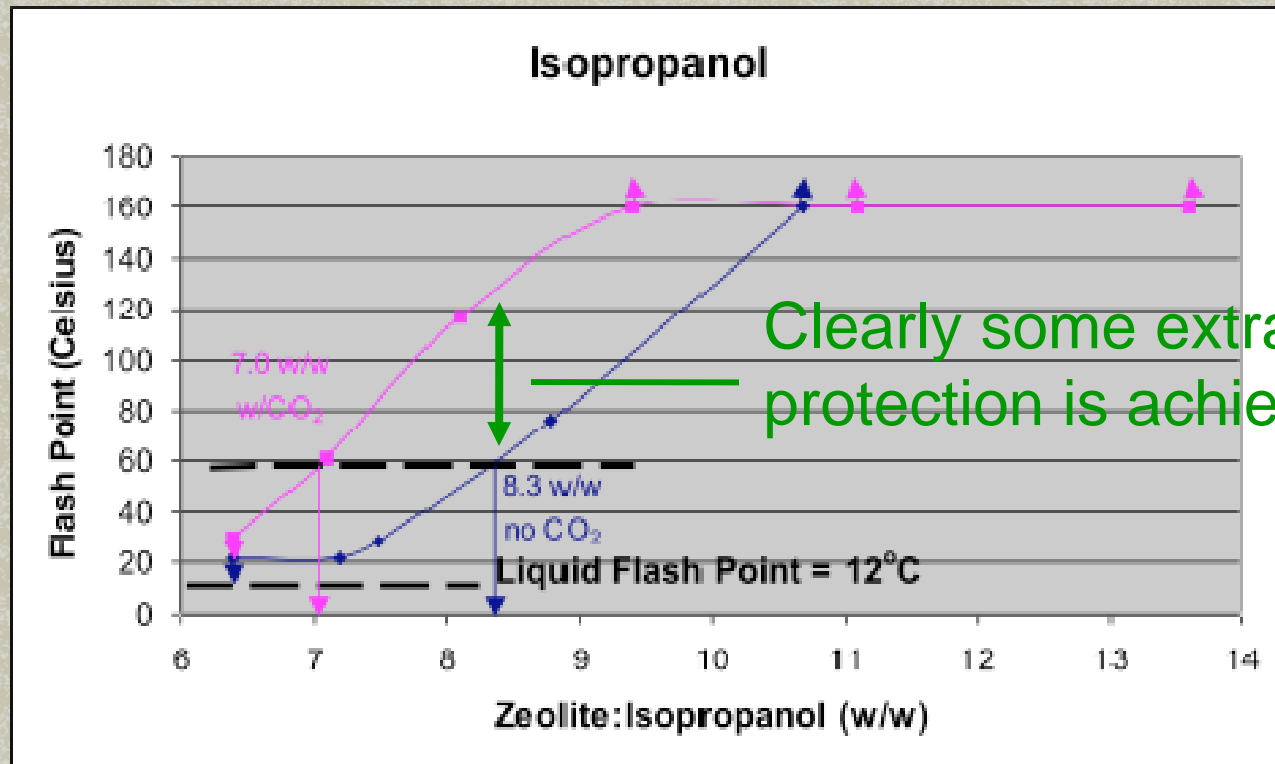
- Typically suppression occurs above zeolite-liquid weight ratios of about 10:1.
  - Such values are typical of the re-commended application levels of ordinary sorbents.
  - e.g. a typical, isopropyl alcohol, flashpoint series:



} Vapor  
Suppression

# A CO<sub>2</sub>-Loaded Zeolite Product is Available\*.


- Idea is to add safety by expelling CO<sub>2</sub> gas as flammable liquid is adsorbed.
- Exhibits some interesting features:



\*Under provisional patent. <sup>13</sup>



# Flammability Suppression Demonstration of a Zeolite Sorbent.



## Demonstration of Addition of Flammable Liquid to Sorbent

- Expulsion of protecting CO<sub>2</sub> gas is evident first.
- Then some minor heating is evident due to the high attraction of the liquid to the zeolite.
- After a short time, the odor of the liquid dissipates.

With thanks for your interest.