
FEW
INTERNATIONAL
FUEL ETHANOL
WORKSHOP & EXPO
HengYe
BOOTH 926

Mol Sieve

Predictive & Preventive Maintenance

A Smoking gun, A Control example and A Glimpse of the Future.

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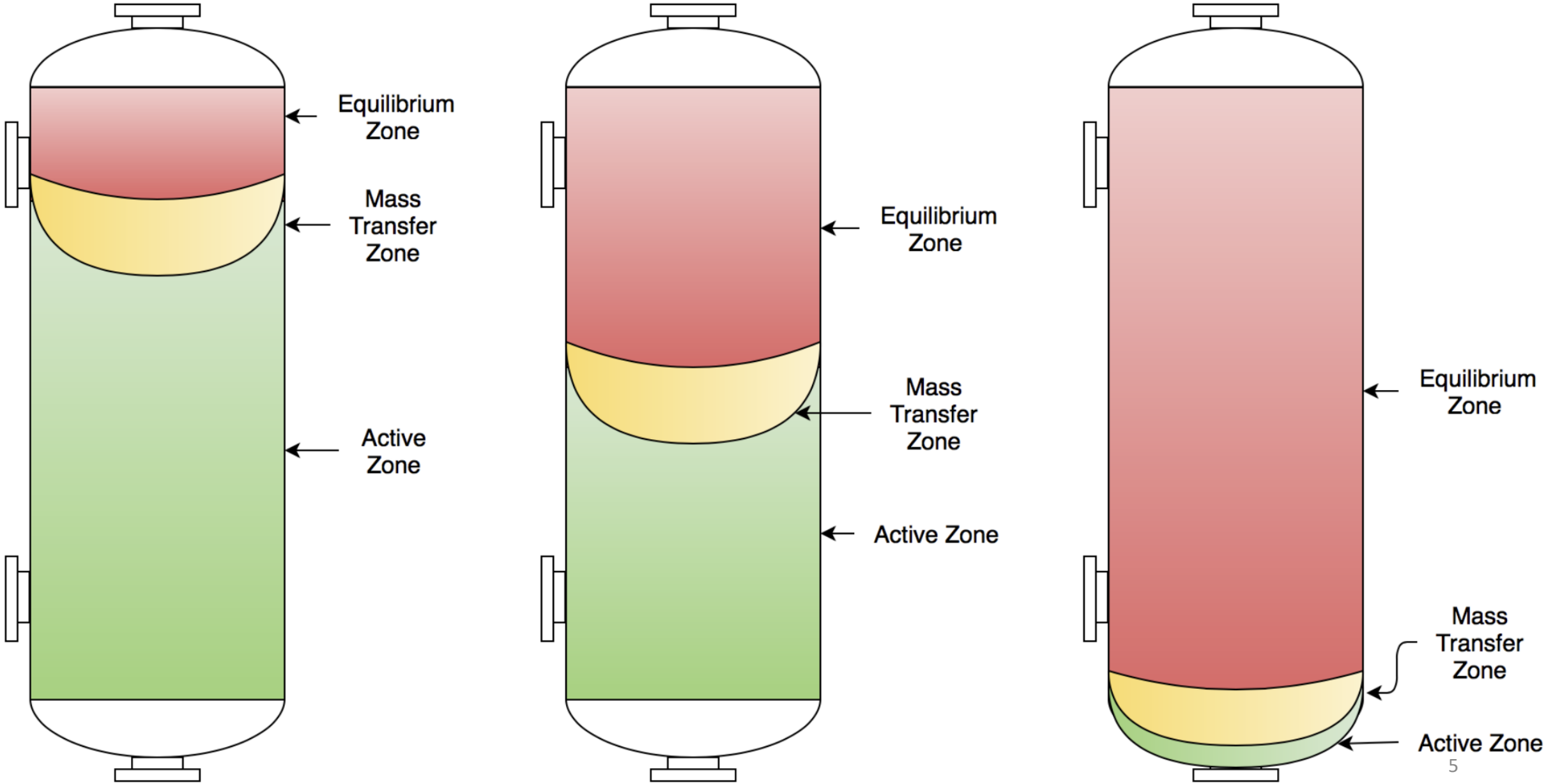
Hengye Inc. Booth #926

18 minutes – I'll make it quick

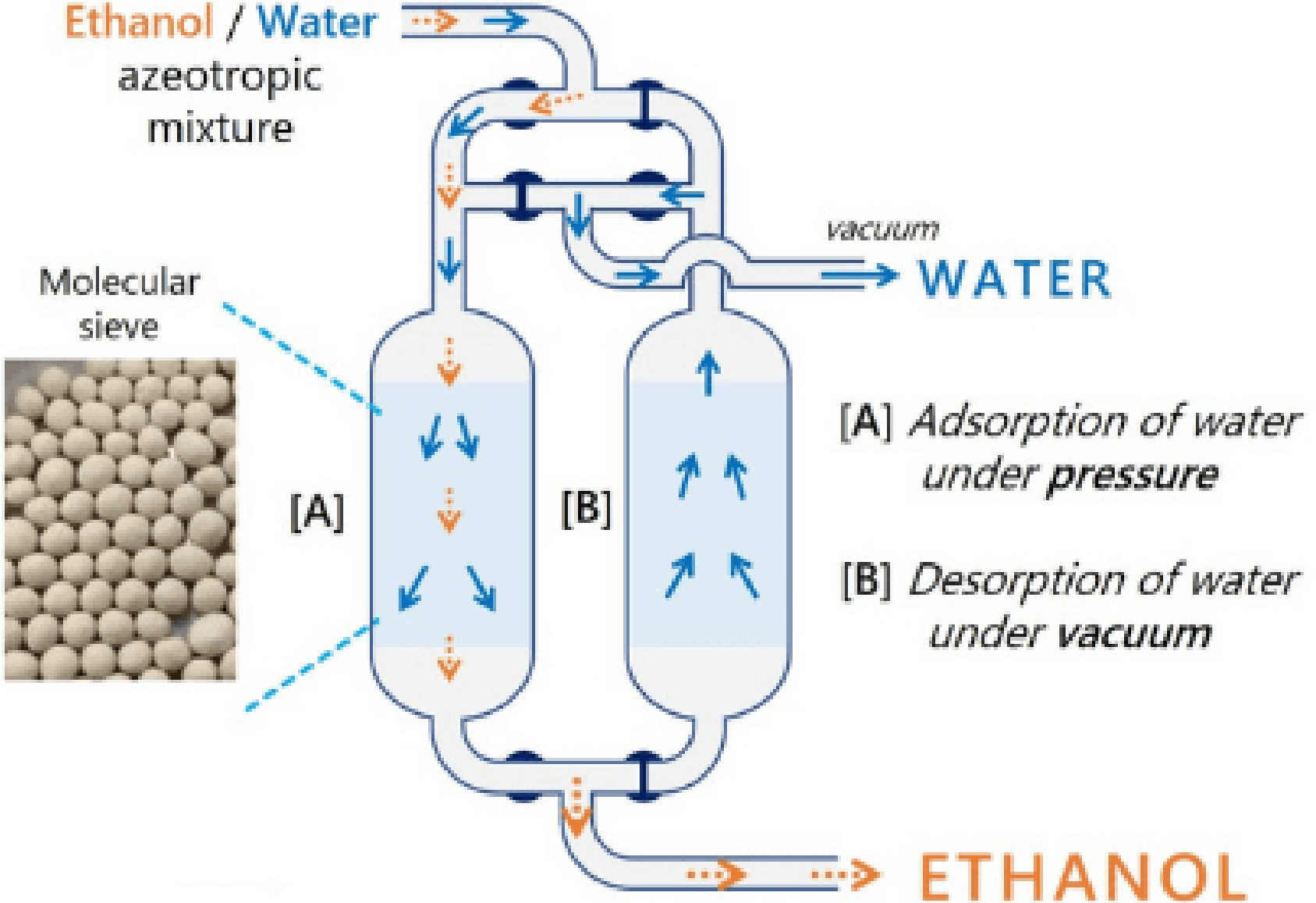
- The intent is to open dialog and give a better understanding of the level of control, predictive maintenance and trouble shooting that is available and the level of control that is available to maximize the productivity and longevity of the molecular sieve drying unit.

The material presented is for common use and NOT to be used to create a commercial product by third parties for sale without express written permission.

Mass Transfer Zone passing through the Molecular Sieve bed during an ethanol bed dehydration cycle



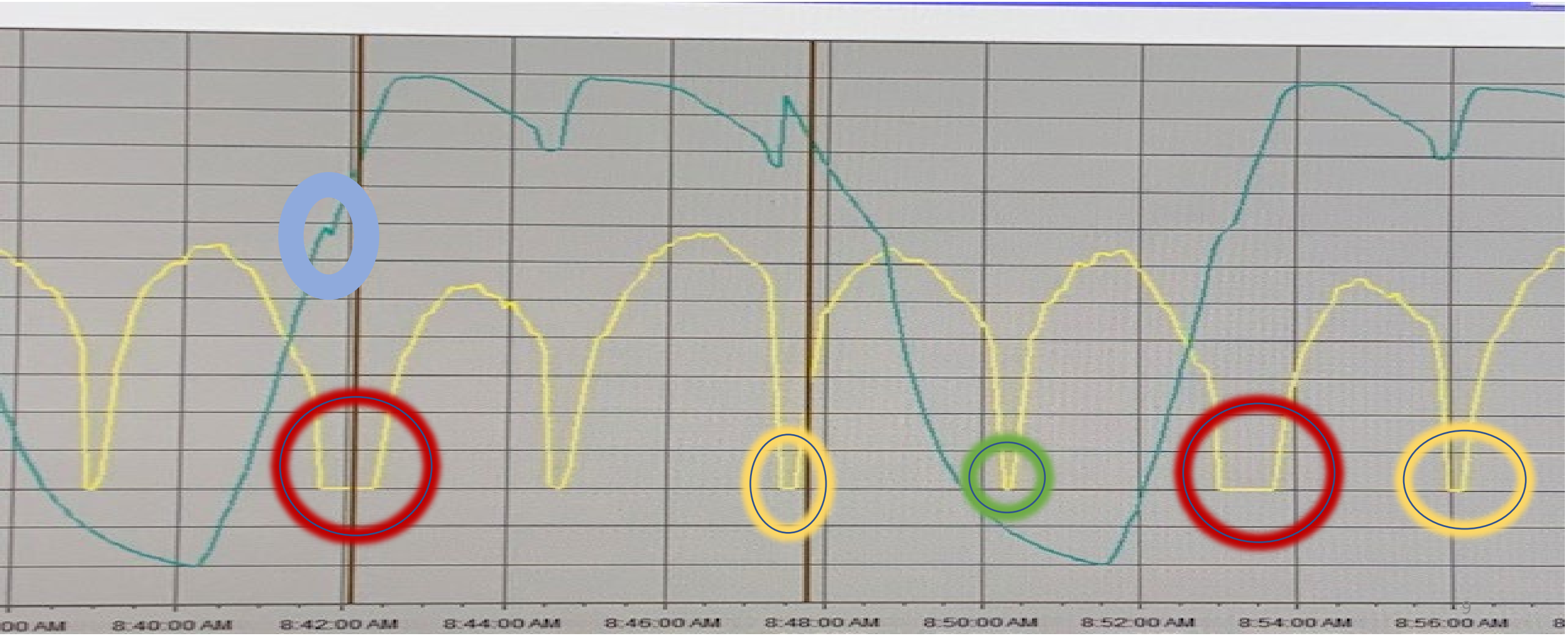

Static water absorption capacity is not as important for
synthetic zeolites as dynamic water absorption capacity.


Ethanol / Water
azeotropic
mixture
vacuum
WATER
Molecular
sieve
[A]
[B]
[A] Adsorption of water
under pressure
[B] Desorption of water
under vacuum
ETHANOL

First the death spiral -

- Channeling within a mol sieve bed is the “death spiral” . Once a bed has been physically damaged to the point of channeling the bed will “eat” itself.
- How do you know this is the root cause of poor production?
- The back pressure valve behavior!
- As the bed struggles to repressure due to channeling the vapor finds the points of least resistance. The open channels in the bed offer little or no resistance, this cause the back pressure valve to close (80%) and stay closed for an extended period. This is an excellent indicator (among other things see my article on how not you kill your sieve beads) of channeling cause by wet dust making “cement”

Real time example

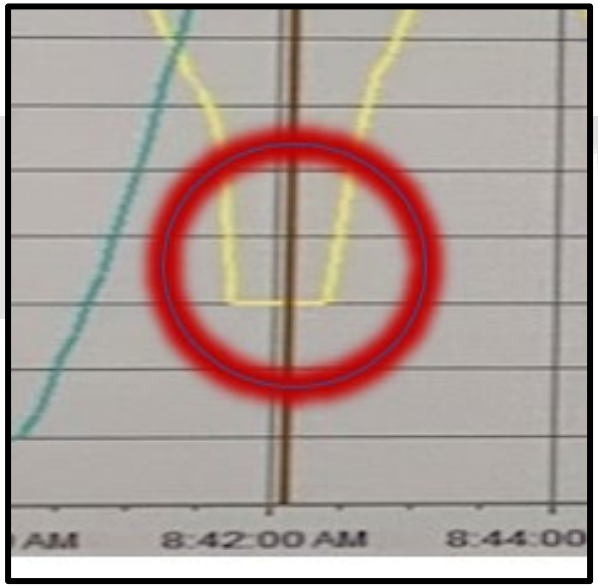


As you can see the back pressure valve is stuck closed….

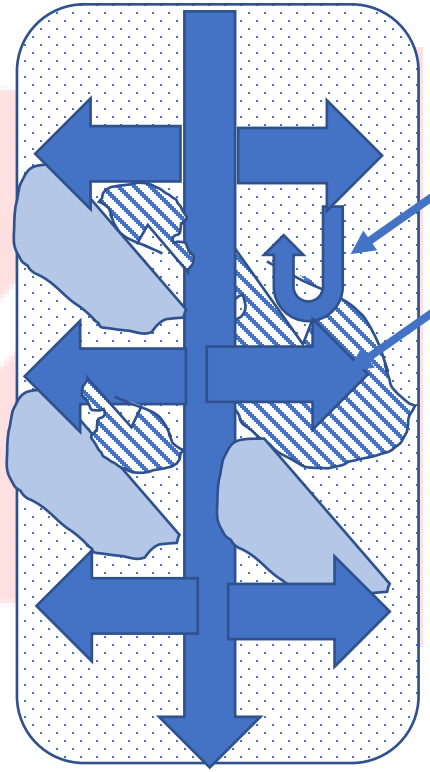
- This indicates severe channeling – Red circle. Another bed that has been damaged, yellow circle, that will continue to degrade
- The “glitch” apparent in the actual bed pressure curve mimics this, sudden pressure change can fluidize the bed causing dynamic physical damage to the beads, blue circle.
- Once channeling is formed all fluid dynamic bets are off, vapor velocities are variable thru the bed, fluidization pockets can form holding and refluxing water further grinding the beads.
- Monitoring the slope of the back pressure valve behavior through the DCS can identify the phenomenon and help prevent further damage to the system and alert the operators to current and potential problems.

What this means

- The “flat line” on the back pressure valve curve indicates the BPV is slamming shut and staying shut, fighting to build pressures as the vapor sails through the channels. With little resistance to flow vapor velocities become excessive (destructive?) and cause further damage, the “**Death Spiral**”



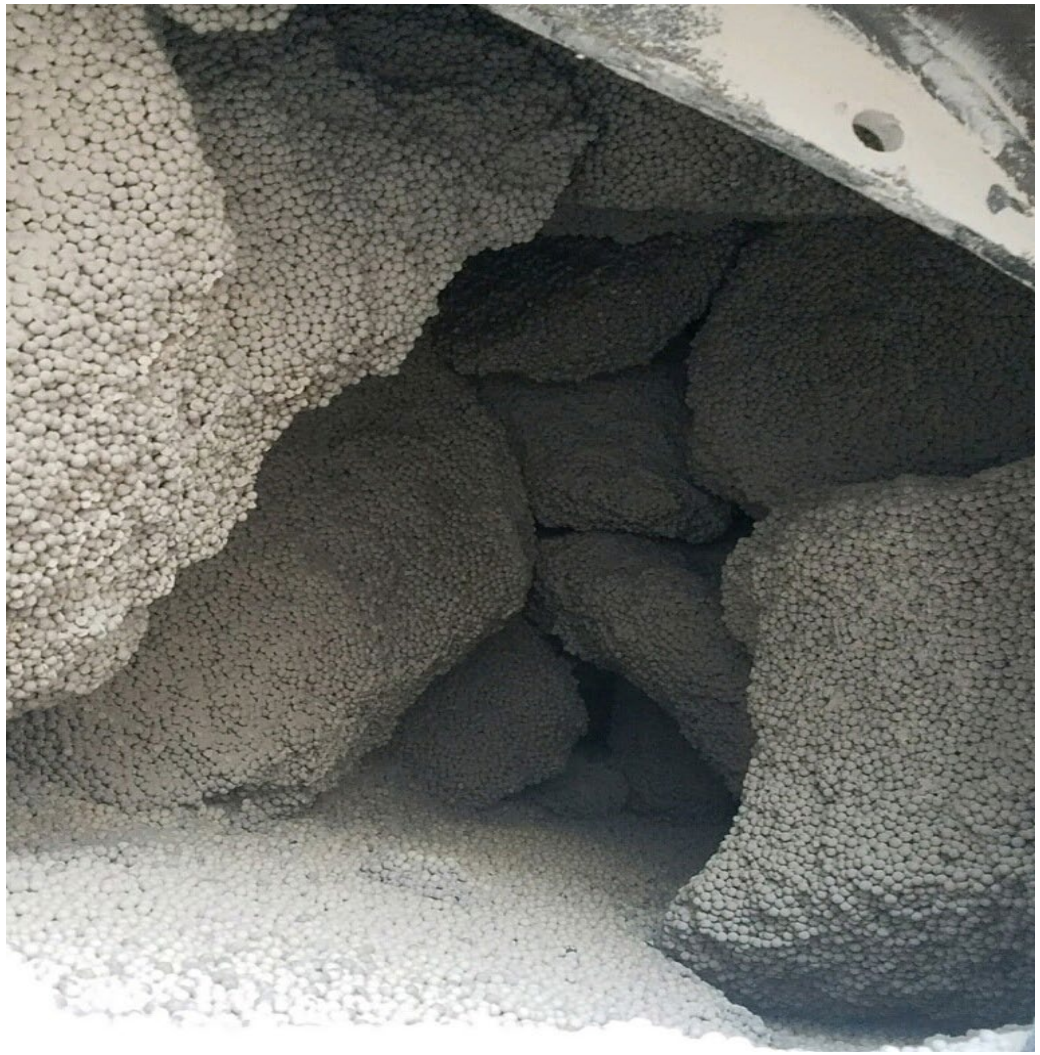
Representation of the inside.



Water refluxing, keeps bed cool

“Dead” arm and zone

Actual picture of the bed after opening

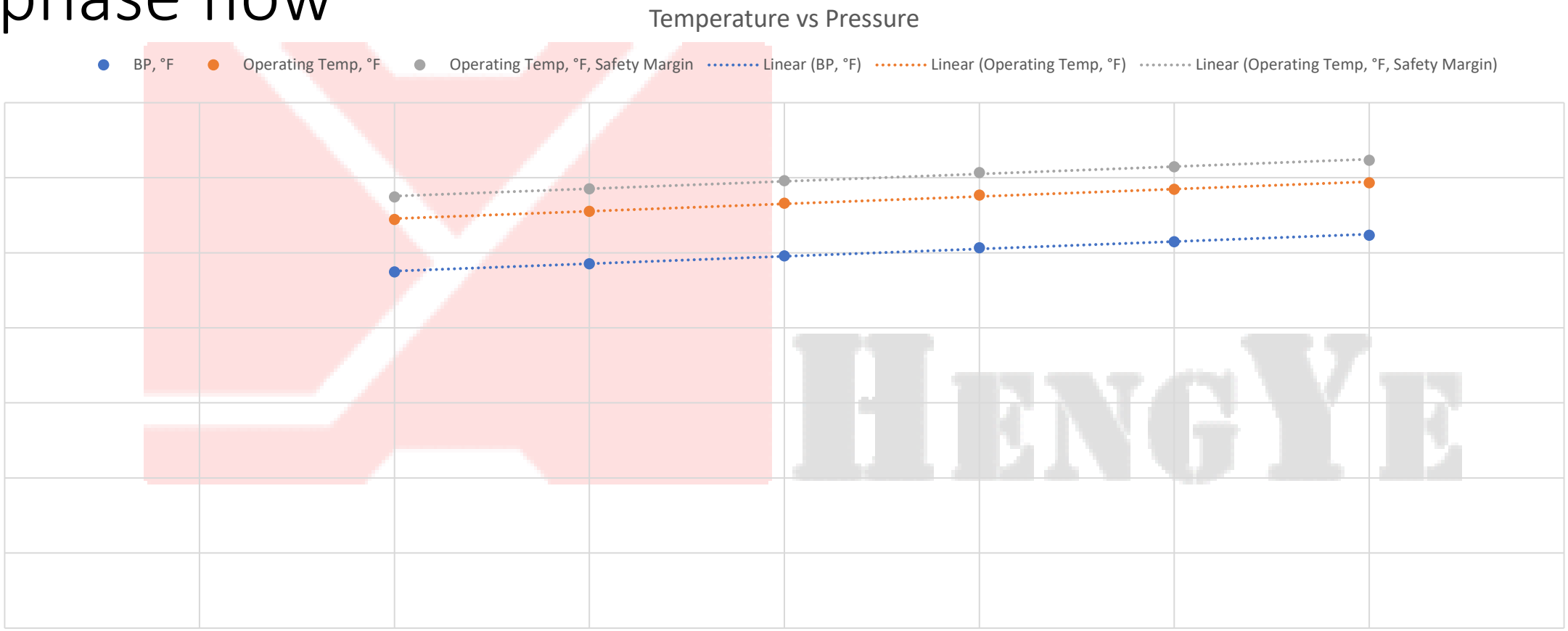


How does this happen – see my previous article* (s) on maintaining sieve beads

- One factor affecting the beads – bed wetting – the wetter sieve beads are the weaker. Its important to maintain SINGEL vapor phase flow.
- Operating at the proper temperature and pressure for the feed quality (proof). 30-50 °F over the condensation temperature of the feed composition at pressure. Ensure the fluid dynamics are in line.
- As an example -I’ve developed a model to automatically monitor the temperature and pressure for the feed composition.
- Currently the T&P come from the DCS, feed proof must be manually input, with instrumentation for proof determination the model can run in real time and either set off an alarm or automatically adjust the pressure / temperature to maintain single phase flow.

*Articles available: Hengyeinc.com

Plot: two schools of thought’ 30 °F and 50 °F Over the BP of various feed compositions. Ideal is somewhere in between to maintain single vapor phase flow



Output Screen For Single Phase Flow Calculation

The equation for the line between the two lines is

[redacted]

Rearranging the equation

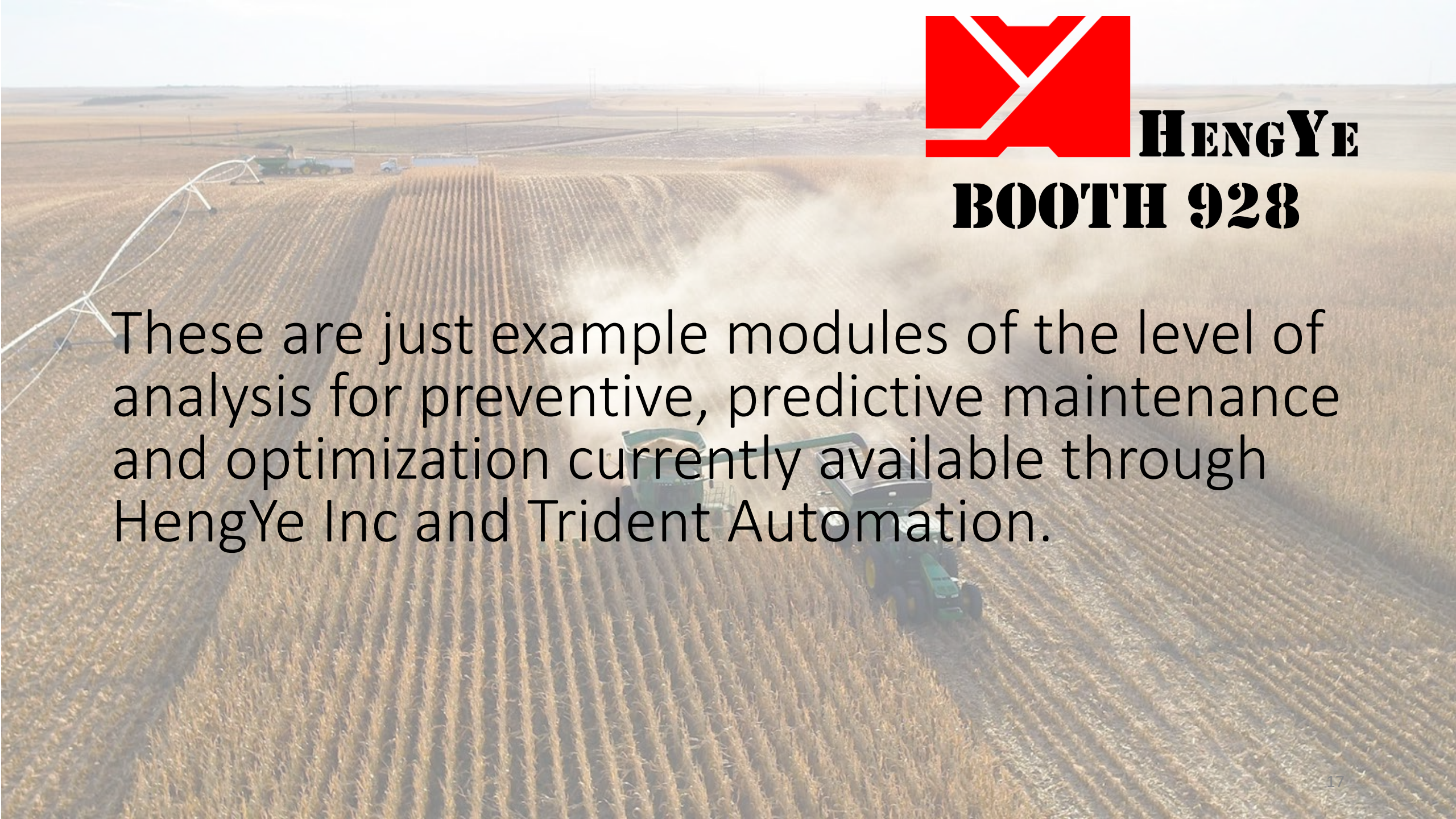
[redacted]

When this equation = 0 then the process is set to run between the two lines. Inputting T&P from DCS and calculating how close the conditions are to yielding "0" is an indicator of efficiency and single phase flow. "0" would be ideal

T, F	P, PSIA	Target
304.9	75	-0.0725

Inputs from DCS

Fit to line, When the target value is +/- 6, single phase flow is insured.



These are just example modules of the level of analysis for preventive, predictive maintenance and optimization currently available through HengYe Inc and Trident Automation.

Rollout: Starts Today

- Phase I : Remote analysis and reporting through Trident access. Allowing us to remotely access a plant DCS, preform analysis and provide report and guidance on the health and performance of a sieve bed system.
  - Not using Trident? -Trident can still assist with getting remote access granted.
    - If you have Trident Workbench and SievePAC, it will be easy to add the analysis software and adjust control parameters for better operation.
- Phase II: Installation of modules through DCS upgrades to automatically monitor critical DCS data and alert plant, Trident and Hengye of potential problems in real time to adjust the system for optimum performance and system protection to avoid downtime. Machine Learning.
- Phase III: Installation / DCS Upgrade to automatically detect and adjust system to proactively avoid problems and optimize system in real time.

How do you get started

- We will be available immediately following this presentation at the Trident Automation booth #1819 as well as the Hengye Inc booth #928.
- Call, text or email me anytime
- Call, text or email Trident anytime
- We can help you understand the current state of your system and gain more control and understanding of your system in real time.

- Questions?