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Technology Evaluations Inc.'s

TEI Fluidizer

TECHNICAL BULLETIN
THE BASICS OF PNEUMATIC MODULATION TECHNOLOGY

AIR FLOW MODULATION

Pneumatic Modulation Technology (PMT) uses air flow to induce material flow. The TEI Fluidizer uses a patented PMT process to modulate air to create a continuous, oscillating air flow using multiple frequencies. These multiple frequencies create an air flow system which avoids development of node/antinode zones that troubled earlier fixed-frequency technology.

PARTICLE SHEAR/WORKING ANGLES

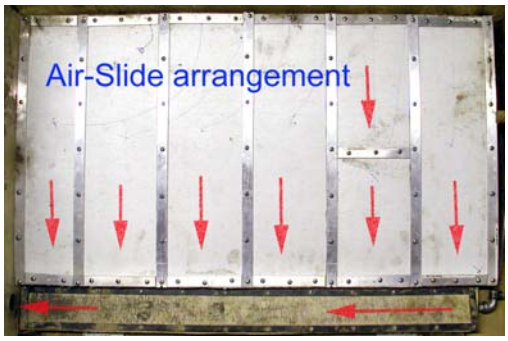
Powders *(e.g. cement and flyash)* have thixotropic properties, i.e. difficulty flowing after periods of rest, because the internal friction of particles increases with both contact-time and compaction; this is commonly referred to as 'warehouse-set'. Some cement 'batches' have an inherently high internal friction, and this may be due to changes in particle size distribution &/or surface chemistry, consequently, these powders require much greater slide-angles and air-flows to fluidize; this is referred to as 'pack-set' (Ref. ASTM C1565). A combination of these two effects can result in large masses of powders accumulating in the bottom of silos.
Fortunately, the multiple frequencies of the TEI Fluidizer apply a gentle inter-particle shearing action to mobilize and separate fine powders that have become stagnant. This inter-particle micro-shearing action is effective in reducing the required working angle of a fluidized bed because it reduces the internal friction & angle of repose. Without this action, the natural working angle of a powder is much steeper, and requires greater slide angles. The effects of PMT will greatly reduce the slide angles, as shown on the back page.

COALESENCE OF AIR BUBBLES/ENERGY

Research has shown that vibrating fluids inhibit the coalescence of fine air bubbles. PMT induces vibrations near the air-slide surface to provide better particle separation, effectively doubling the particle to air contact efficiency. This increase in efficiency is one of the reasons that the TEI Fluidizer needs only one-half the compressed air used by continuous air systems. For more information on this research, please visit our web site www.TechnologyEvaluations.com

DEMONSTRATIONS

To demonstrate the effect of PMT using multiple frequencies, a plexi-glass box was used to simulate a fluidized bed with full floor coverage of air-slides. As shown below, the box was designed with seven air slides on a 4 degree angle with a single discharge point (on the left towards the front). The box was capable of holding 1/2 ton of material and was set up to provide air flow using either continuous flow and using PMT.



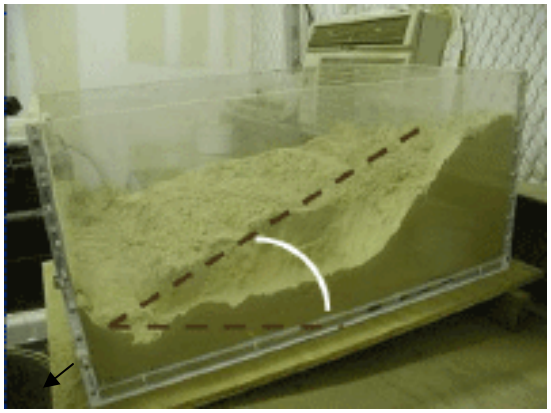
Bench Scale Demonstration Box Details

- Dimensions: ~ 40"W x 30"D x 24"H
- Air slides:
  - Six Floor (one divided)
  - One Discharge Trough
- One discharge point (lower left hand side of picture)
- Vertical air flow 1 to 10 ft/min
- Single and multiple flow capability: 0.5 to 55 Hz
- Air-slide angle: 4 Deg.

CLASS "C" FLY-ASH DEMONSTRATION

Demonstrating the effect of multiple frequency PMT is much easier to see with Class "C" Fly Ash than cement, because its normal airslide working angle is 16 degrees (verses 8 to 10 degrees for cement).

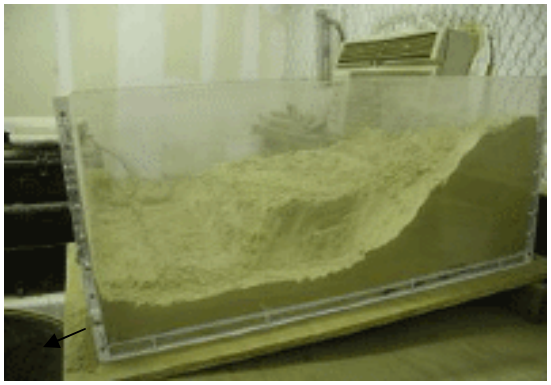
Picture #1 - Application of PMT to 2 Air Slides at 40% Less Air Flow



A continuous flow air supply was applied to the Demonstration Box containing Class C Fly Ash at a vertical velocity of 5ft/min. The continuous flow successfully discharged much of the Fly Ash, but could not remove the material below the 16 degree working angle (normal for Class C Fly Ash). PMT with multiple frequencies was then applied to the discharge air slide in front and the air-slide furthest to the left using only 3ft/min of air flow.

Picture #1 shows the original slope of the powder using continuous air flow (dotted line is approximately 16 degrees), and the effect of PMT on the two air slides where it was applied. Note the shallower depth of Fly Ash where PMT is applied.

Picture #2 - Application of PMT to 3 Air Slides at 40% Less Air Flow



As shown in Picture 2, an additional air pad was activated at 3 ft/min. Note the plateau effect where the second air slide was activated using PMT. It clearly shows that PMT can remove substantially more powder than can be moved by continuous air flow.

The reduction in air flow has since been tested, and it has been shown that PMT with multiple frequencies can generally use one-half the flow and still provide the same results. In some applications air flow can be reduced by up to 80%. Less air flow has significant implications on energy costs, compressor loading and bag-house loading. Using less air also increases the bulk density of the fluidized mass, which helps increase silo discharge rates.

Picture # 3 - Application of PMT to 5 Air Slides at 40% Less Air Flow

Picture #3 shows five activated air slides using multiple frequency PMT. Note the slope of the material is a significantly less than that using the traditional continuous air flow system. The effect may seem minor in a 40" wide storage bin, but it has substantial implications of capacity availability in a storage dome 100 feet across.

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