

MULTI-ANGLE "COMBO" SCREENING

by Paul Smith



Within the last two decades, there have been rapid and marvelous technological advances in the screening machinery used by the aggregate, mining, and bulk material processing industries. Among these include the innovation of multi-angle “Combo” screens that combine characteristics of horizontal and incline screens. New questions are raised: “When is a Combo screen suitable, and will it provide any advantage over incline or horizontal screens?”

To properly address these questions, one should first have a basic understanding of screening theory.



The Screen test facility located in Eugene, OR (USA)

TEST CONDITIONS

The objective was simple. Test (3) 8’x20’ triple deck screens in a side-by-side comparison, one being a triple shaft horizontal screen, one being an inclined screen, and the third being a Combo Screen. The plan was to run the same material over all three screens in all available configurations for each design, take material samples, and compile the data in an effort to navigate through the myths about screening.

The testing began. Materials including pit-run sand & gravel and shot-quarry Basalt material were separated on all three of the units. All were equipped with the same media consisting of a 25mm top deck opening, 20mm center deck,

and 12mm bottom deck. Each machine was tested at every adjustment to frequency (RPM), stroke length, and stroke timing angle. The inclined screen was operated at both direction of rotation so as to attempt to further retard material travel speed. Material samples were taken from belt sampling devices while scales monitored production rates. These samples were then painstakingly sieved to provide a gradation analysis that could indicate the quantity of undersize material being inefficiently “carried over” on each deck. The expectation was that trends would surface, indicating under which conditions each screen design was most productive and/or efficient.

MIXED RESULTS

Obviously there were some significant observations between the machines. One of the biggest variances between the styles clearly pertains to the material travel speed. All things being equal, the gravity prevalent on inclined decks obviously produces a higher material travel velocity than the horizontal surfaces. What was observed was that as the material would pick up velocity, bed depth would become thinner thereby increasing volumetric capacity while introducing fines to the screening surface faster. However, as velocity increased, probability of separation of near-size material would also diminish, which in most cases contributed to increased carryover (inefficiency).

Clearly, there were some definite trends that both reinforced some existing assumptions, as well as provided some valuable new information. In general, these include the following:

Horizontal Screening Characteristics:

- Produces a material travel speed of 50-70 feet-per-minute in a consistent manner
 - Potential for thicker bed depths which can limit volumetric capacity
 - The material does not accelerate as it moves farther down the screen, thus probability of separation remains constant for increased near-size separation
- The vibrating mechanism produces a longer, elliptical stroke pattern and generates more

“G” forces, which is more favorable for:

- Dislodging coarse particles that might potentially plug coarser openings
- Resist the blinding of finer, sticky materials that might potentially plug smaller openings
- The relationship of the trajectory to the screening media is at a true right angle, thereby allowing true nominal spaced openings for precise separations



An 8x20 3-deck horizontal screen at the test facility

Based on this data, horizontal screening is favorable in the following conditions:

- When the incoming feed gradation has the potential to be inconsistent
- When the material possesses characteristics could potentially plug or blind the openings
- When efficient separation and minimal carry-over of near-size material is a priority

Incline Screening Characteristics:

- Inclined screens produce a higher travel speed (70-100 feet-per-minute) that accelerates the material as it moves down the deck
 - Yields a thinner bed depth than a flat screen providing increased volumetric capacities
 - As material travel speed increases, probably of separation decreases; thus an incline screen can generate a higher % of carry-over of near-sized materials
- The vibrating mechanism typically produces a smaller, circular stroke pattern that generates fewer G forces, which is favorable for:

- Keeping finer material closer to the screening surface in a tumbling manner
- Applications where large volumes of feed material must be rapidly conveyed out of the feed area



An 8x20 dual-shaft incline screen at the test facility

Based on this data, inclined screening is favorable in the following conditions:

- When high volumetric capacity is a priority
- When large volumetric surges of material potentially occur

Multi-Angle “Combo” Screens

Combo screens were designed in an effort to combine the advantages of both inclined and horizontal screens. The screen is equipped with (3) parallel decks that begin with a 20-degree feed section and gradually flatten to a horizontal “sizing” discharge section.

Installing sloped sections at the feed end mimics an incline screen in that gravity rapidly accelerates the travel speed of the feed material up to 100fpm to **reduce bed depth**. This reduced bed depth enables fine particles to “stratify” through the coarser particles and onto the screening surface much faster, where the particles can then find more opportunities to be passed through screen openings.

As the deck gradually flattens out to the horizontal “sizing zone” section towards the discharge end of the screen, the “near” size and “over” size particles that are not initially separated on the middle and top decks decelerate down to a travel speed as low as 40fpm. This reduced travel speed mimics a horizontal screen in that it provides a higher screening efficiency of near-sized material.

The design achieves its objectives of combining the best characteristics while mitigating the undesirable traits of traditional designs, which are to:

1. Provide increased feed production by as much as 25% over conventional horizontal screens
2. Improve the screening efficiency by as much as 10% over conventional incline screens



The Multi-Angle COMBO screen

Combo screens will in conditions where screening efficiency is a priority, large volumetric feed 'surges' are 'possible or where deposits containing a high percentage of fines exist