**APPLICATION BRIEF**

**GYPSUM WALLBOARD DRYING**

**Major Benefits for TIP450**
- Continuous board moisture, quality and defect detection
- Accurate and detailed deck-to-deck dryer-kiln balance information
- Historically trended board moisture
- Reduced scrap and rework from startups and production gaps

**Major Benefits for TRS100**
- Historic trending for mixer
- Continuous mixer monitoring, alarming and control (exothermic reaction)
- Reduction in scrap and the number of rejects
- Consistency in thermoforming complex shapes
- ISO9000 reporting for each manufactured part

**DESCRIPTION OF APPLICATION**

Gypsum is Calcium Sulfate - CaSO4. This is a naturally occurring element. Initially the gypsum needs to be physically refined down to a super-dried powder. This is usually done in a “ball mill” machine and then dried in a “calciner.” From there the powder is mixed with water and several other chemicals in a mixing drum and then extruded out into a paper “sandwich.” It is very critical that this sandwich immediately start to harden and begin to crystallize. After a set amount of time, the continuous sheet of gypsum can be cut then transferred into a multi-deck drying-kiln where it spends the next 35-to-40 minutes. The moisture content of the boards after this must not be too high (brittle and weak boards) or too low (heavy and sagging boards).

The following is a more detailed process description:

**Hard Edge Mixer:** this is found at 75% of the plants. Separate mixer prepares all the above ingredients except for foam. This high-density mixture is used to makeup the outside rails of the board. This is done so that the board has more holding strength for construction screws or nails.

**Forming line:** a long (1000-to-2500 ft) rubberized belt section running on top of steel rolls. The mixer continuously spills out the gypsum ingredients on top of a sheet of paper riding on this belt, and is then sandwiched under another sheet of paper being fed just before the forming plate. Because the slurry is going through an exothermic reaction on the forming line, it wants to expel its water content – this is referred to as a “hydrophobic” condition. This is where the first 8 TRS100 MIC SENSORS are mounted.

**Knife:** Two horizontally rotating cylinders with serrated knife blades on each. The knife rotation is synchronized with the line speed to produce an exact length of board.

**Tipple and Infeed sections:** The tipple is a table which indexes the grouped boards onto the proper dryer deck infeed section. This loading sequence is usually done with FIFO logic.

**Infeed hydration:** This multi-deck section stages the boards for the dryer. A 10-deck operation will slow the linespeed down by 10 times (combined with a two board wide grouping, this equals a linespeed reduction of 20 times). It is important that the gaps in between boards are closed prior to them going through the dryer (prevents edge-burn). This is where the TRS100 SENSOR 9 is mounted.

**Kiln-dryer:** Large multi-deck and multi-zone dryer using fossil fuel burners and air circulation fans to remove a specific amount of moisture from the boards. Each of the
zone sections is individually atmospherically controlled. Zone 1: The first section of the dryer. Begins with the “cold-side” and ends with the “hot-side” in order to prevent thermal shock of the boards. This zone has the highest air temperatures in the entire dryer operation. Zone 2, etc: Begins at the “hot-side” and ends with the “cold-side.” For some dryers, this is the final zone, some others will have several more atmospherically controlled zones that are similar to zone 2, but with even lower process temperatures.

Dryer Manufacturers: Grenzebach/AKI (Ger/US), Gyptech (Can), COE (US), Flakt (Ger).

**Outfeed:** This conveyor section immediately following the dryer pulls a gap between board groups so that they can be handled separately. This is where the TIP450 FIXED

**IR SENSOR ASSEMBLY** is mounted.

**Drop Gates:** Pneumatically activated steel bars that actually stop the boards on the outfeed conveyor until it is their turn to be released. This operation is sequenced with FIFO logic (first in – first out).

**Cascade:** This conveyor section “cascades” the boards from the outfeed multiple decks down to a single deck.

**Pullout section:** This conveyor section immediately following the cascade is either bare metal rollers or rollers with rubber belts on top. This section is sped up so that there is a gap pulled between the board groups allowing them to be handled individually. This is where the TIP450 SCANNER is mounted.

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**TRS100 System**

**PROBLEM(S)**

**Calcined Board:** overdried gypsum board. The complete removal of H2O from the gypsum results in the breakdown of the gypsum crystal structure – resulting in chalky, easily pulverized material. Makes very angry customers!

**Paper Blows:** very large area where the paper is separated from the gypsum. Caused by poor **paper bond** (adhesion) properties of the mixture.

**Paper Blisters:** smaller than blows, but also paper separation from the gypsum. Usually the size of a soccer ball or smaller. Caused by overly aggressive application of heat in the dryer – especially in the first half of the drying process.

**End Burn:** calcined end sections of the boards. Usually much more prevalent on the trailing edges of the boards because the direction of the airflow is against these edges for every dryer zone after zone 1.

**Voids:** small holes in the gypsum board. These can be caused by a few different mixer-related problems: 1) large air bubbles from the soap –or- 2) air trapped in the mix by cavitation inside the mixer drum. Plants use vibration tables just past the mixer outlet to try and alleviate this problem.

**Lumps:** often referred to as “turd”, these can be very big problems for a plant. If one of them becomes wedged at the forming plate, they can cause a **paper break** which will shutdown the entire line for 15-to-30 minutes. The cause is gypsum mix material that gets stuck in the mixer after contacting the hardening catalyst, therefore pre-hardening into a lump – usually about the size of a snickers bar.

**Knife Cuts:** problems at the knife cut occur for a few different reasons: 1) the boards became too hardened and brittle by the time they reached the knife, resulting in shattered gypsum crystal just upstream of the knife cut, or 2) the vertical
alignment of the two knife blades is off, causing the delicate board to flex across the rollers and the crystal lattice structure to fracture. As a result, too much water is released too easily in the drying process. Look for this if you see end burn problems.

**Water Spots:** literally water spots from the end of the dryer section. This is caused by high moisture air escaping the end of the dryer, then condensing onto the surfaces over the boards. Typically much more of a problem for boards coming off of the top deck.

**Overlapped Boards:** stacked boards caused by improper loading at the Infeed section.

**Foam Density Variations:** Caused by fluctuations in the mixer foam additive.

### RAYTEK SOLUTION

The Raytek **TRS100 system** provides customers a continuous and sensitive monitoring system for the mixer process, alerting them to any deviations or problems before they result in expensive lost production. This system replaces the old fashioned technique of using a thermocouple to measure the exothermic temperature rise in a cup of the slurry. We use nine MIC sensors to measure the critical exothermic reaction of the mixer output slurry as it travels to the dryer entrance. Each sensor has an internal ambient air temperature monitoring and the system can use this to compensate for any temperature losses. The system OPC outputs can be integrated for closed-loop control of their mixer additives. Historical trending shows any process deviations over time.

The **TIP450** system is the most sensitive system available for evaluating final board quality. Scanning each set of boards with over 12,000 temperature points per second as they exit the drying operation, the system accurately measures the internal board moisture by relating it to the temperature. In addition, with this high resolution, the customer can see virtually any board defect that may exist. The dryer balance from deck-to-deck is displayed with averaging for up to 500 boards per deck. Overall board moisture is trended over time and includes alarm outputs for high or low moisture problems.

With a single **Fixed IR** sensor right at the dryer exit, the system watches for ambient air temperature losses and internally compensates them out.

### BENEFITS

Because of its continuous monitoring, the **TRS100** system allows the user to “set it and forget it” on their mixing process. The system easily pays for itself in a short amount of time by alerting for process problems before they amount to a large amount of scrap and rework.

The **TIP450** system has two main benefits:
1) The detailed kiln balance allows the customer to adjust air dampers for maximum efficiency and board quality. The fuel savings and board quality improvements are typically very large.
2) The complete board moisture monitoring and defect detection offers an unprecedented “X-ray vision” in the boards. The value of this system has been shown continuously in the first day of operation with the ability to illustrate problems and root causes. The moisture trending allows the customer to carefully watch the overall quality over time for each of their recipes.