

Problems with Continuous Fly Ash Level Measurement

Until the mid 1980's no one cared too much about the continuous level measurement and indication of Fly Ash. Fly Ash that was removed from the Precipitators was hauled off to a "pond" where it was dumped. The pond kept the ash from becoming air borne, and when one pond was full another was made. This cycle continued for many, many years.

In the mid 1980's the EPA decided that just dumping the spent ash in ponds wasn't something that would be allowed to continue due to environmental issues. Coincidentally, about this same time, someone discovered that the fly ash had value as a low cost additive and binder to cement used in road construction. So, the ash was stored in ash silos and sold to the various companies who had a use, a need and the willingness to pay for fly ash. So everyone seemed to be happy with the proposed changes in ash disposal. That is until the silo was full and there was no place to put the new ash that was constantly being generated by coal fired power plants.

Based on the "new" regulations, if a power plant had no place to put the ash, they could be forced to shut down, since they could no longer just dump the ash. The importance of a continuous fly ash measurement was born.

Problems with the continuous level measurement of Ash:

Coal types: Power plants use coal that is mined from many locations both in and sometimes outside of the US. Some of the different coal types are Anthracite, Bituminous, and Lignite. The type of coal used depends on the plant's location and coal source availability. All plants want to use coal with the highest BTU output, and the mixing of coal types to get consistent BTU output occurs. Each different coal type has different physical characteristics in regard to density, dielectric constant, BTU, etc. The ash that results from this also has different characteristics.

Ash stratification: As different types of coal are burned and the fly ash removed to storage silos, stratification occurs. The first few feet may be of one type of ash, the next layer from a different coal/ash type, etc. until the silo is full. Each type of ash layer has different characteristics of density, dielectric constant, abrasion, etc.

Technology approaches:

- **RF / Capacitance** - Due to the stratified layers of ash with different dielectric constant this technology did not produce acceptable results. Level measurements could be off as much as 30% or more. The addition of a series of point level sensors that were tied to the continuous measurement provided an "Auto-Cal" design that gave somewhat acceptable results but the price and installation costs were prohibitive.

- **Ultrasonic** - Dusting, angle of repose, long measurement ranges and occasional higher temperatures produced unpredictable and unreliable results.
- **Plumb-Bobs and Yo-Yo's** - These provided acceptable results until the ash coatings and abrasiveness created mechanical problems. The cables that were typically wound up on a spool device when retracted would bind, and once coated, would not fit on the spool causing system failure. This required the devices to be disassembled and rebuilt. The maintenance costs incurred eventually became unacceptable.
- **Brick on a Rope** - Most plants used this method as the only sure-fire approach, but this required someone going to the top of a 60 ft. - 120 ft. silo in all seasons and weather conditions, and dropping a gauge rope with a weight into the ash silo. Typically this was not done per plant procedure, records were forged, readings were inconsistent and the result was that the ash level information was not reliable. Personnel safety issues also played a role in making the automation of this a priority.
- **Radar** - Although not as problematic as Ultrasonic with dust conditions, the long measurement ranges and low dielectric constants (poor reflectivity) of different ash types proved to be problems in many installations. Radar systems that were able to cope with the measurement conditions typically were priced over \$5000 - \$7000. Lower priced "Pulsed Time of Flight" radar systems have attempted this measurement with poor to marginal results.
- **TDR** - The TDR technology has proven to be the best available technology for continuous level measurement in fly ash. The characteristics of the TDR technology make it independent of dielectric issues, unaffected by dust conditions and most coatings on the sensor. However not all TDR's are equal. Many TDR systems do not have the sensitivity required to measure the low dielectric values of fly ash. Many TDR systems do not have a Single Cable sensor design that can make this measurement, and will also hold up to the mechanical forces and abrasion of fly ash. Lastly, a high amount of Electrostatic Discharge (ESD) can be generated from fly ash. The selected TDR must be able to handle the ESD that can be several thousand volts.
 - The DR7100 comes standard with a 8mm Mono cable sensor that is capable of withstanding 7700 pounds of downward force.
 - The DR7100 is capable of measuring the lowest dielectric constant that occurs in fly ash.
 - And the DR7100 comes standard with 16,000 volts of ESD protection.

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