spray research, inc.

Capabilities for Development and Evaluation of Advanced Mist Eliminator Designs

spray research, inc. has developed several unique laboratory and on-site droplet measurement capabilities that deliver cost-effective performance evaluations of advanced mist eliminator systems. These innovations promise to greatly accelerate the pilot-scale design and development of these advanced systems and to significantly reduce the plant disruptions of carry-over performance testing on full-scale mist eliminator installations.

spray research, inc. has developed custom optics that allow the rapid, non-intrusive laser phase Doppler (PDPA) evaluations of prototype advanced mist eliminator designs over the entire cross-section of test vessels up to 2.2 meters square. Traditional use of PDPA and video imaging instruments require the insertion of bulky probes into the gas stream. These probes significantly disturb the gas flow and their size severely limits the locations at which measurements can be taken. Extensive modifications to the test vessel are often required in order to use these older probes and the process of gathering truly representative performance data is slow and frequently compromised.

spray research, inc. has also designed a PDPA insertion probe for on-site use at full-scale mist eliminator installations. The probe can be used in either vertical or horizontal vessels and can measure carry-over to a depth of 3.0 meters. Unlike current probe technology that requires the expensive and time-consuming installation of intrusive alloy guide rails, spray research, inc.'s new probe design can be easily inserted through existing inspection ports and manways. Since the probe does not rely on fixed tracks, sampling locations can be chosen with great flexibility. With the relatively simple installation of additional ports, carry-over measurements at multiple elevations downstream of the mist eliminator are easily performed. the new probe reduces the time required for a typical full-scale mist eliminator evaluation by 65%-80%.

Background On Advanced Mist Eliminators

Mist eliminators are used to remove slurry droplets from the flue gas exhaust of the large wet scrubbers found at many large (primarily coal-fired) electrical power generation plants. The scrubbers are designed to clean the flue gas of particulates and acid rain constituents (sulfur compounds and nitrogen oxides) by spraying the gas with a large volume of limestone slurry. Problems with mist elimination systems have been identified as a major cause of scrubber outages which result in increased operating and maintenance costs.

In the flue gas desulfurization (*FGD*) market, utilities are exerting strong downward pressure on scrubber capital and operating costs. This has led many Engineer/Constructor firms to pursue advanced scrubber designs that operate at higher gas velocities. For new system designs, a higher gas velocity reduces the diameter of the scrubber and, consequently, the capital costs. For existing systems operating with gas by-pass or an adjacent uncontrolled unit, emissions can be reduced at little capital cost by scrubbing this additional gas with the existing scrubber operated at an increased gas velocity.

The higher gas velocities which are basic to both these options can cause severe problems with mist eliminator performance, particularly in counter-current scrubbers. In these units, potentially large amounts of slurry carryover can result. New mist eliminator designs that are capable of operating efficiently at higher vertical gas velocities are now entering final development.

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New Laboratory Capabilities Detailed

The rapid and accurate evaluation of these new designs is the purpose of spray research's development of its non-intrusive measurement system and process duct test section. Utilizing custom optical components allows the lab's DANTEC phase doppler particle analyzer (*PDPA*) probes to be mounted outside of the duct section, eliminating the sampling biases associated with introducing physical probes into the air stream. The external probes are mounted on an X-Y-Z traverser which provides rapid sampling of the entire 0.9 meter square duct cross-section over a 4.0 meter length. The horizontal process duct test section can deliver free air velocities of up to 15 meters per second.

Experimental mist eliminator evaluations with the complete non-intrusive PDPA system, including the X-Y traverser, can also be performed on-site at existing R&D facilities. Maximum sampling cross-section at a single orientation is 1.2 x 1.2 meters. By rotating the instrument, full duct cross sections of up to 2.2 meters square can be readily sampled.

Evaluation of Full-scale Mist Eliminator Systems

Of course, bench- and pilot-scale testing of mist eliminator designs cannot guarantee that the full-scale installation will meet performance specifications. There are several accepted methods of measuring mist eliminator carryover in full-scale systems. The PDPA is considered the most accurate, although highly trained personnel are required for its proper setup and operation. Other accepted, although less accurate techniques include MgO/treated paper and AIMS hot-wire anemometry.

An adaptive fiber-optic PDPA probe designed by spray research, inc. can be inserted into a horizontal duct section by way of standard access ports [as small as Ø4" in some cases]. When used in vertical sections, spray research, inc.'s new probe can be inserted through existing inspection ports and manways. Unlike other current PDPA probe technology, this new probe does not require the expensive and time-consuming installation of intrusive alloy guide tracks above the mist eliminator. Disruptions to normal plant operations are largely eliminated. Large cross sections of the vessel can be rapidly evaluated. Since the probe is not constrained to fixed tracks, the sampling locations can be chosen with great flexibility and suspected trouble spots rapidly evaluated. If appropriate additional ports exist or are installed, the new probe can be used to cost-effectively evaluate the mist eliminator at any number of downstream locations.

Unfortunately, all probes are intrusive assemblies. Our probe has been carefully profiled to minimize distortion of the flow field and has a clear width of about 70 mm normal to the flow direction, and a clear aperture height of approximately 650 mm. A low-pressure air purge and desiccant system is incorporated into the probe to reduce fogging and wetting of the optical components.

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