

ONLINE DEVICE OR INSTRUMENT AND METHODOLOGY TO MEASURE FLY ASH PARTICULATE OPTICALLY IN INDUSTRIAL

IITM Technology Available for Licensing

Problem Statement

- In the present era, the opacity monitors based on optical extinction & other scattering based instruments are well known in the art for stack dust monitoring.
- A few prior arts device/techniques have discussed related to conventional dust monitoring instruments which follows new standards & regulations for emission limits, however **unable to indicate & measure** the true value of **emissions** due to the interference of the **droplets/water aerosol** along with other **PM emissions** including other drawbacks.
- Hence, there is a need to introduce present invention which mitigates above challenges.

Technology Category/ Market

Technology: Optical opacity monitoring devices;
Industry: Power Plants, Cement Plants, Chemical Industries; **Applications:** Glass Plants.
Market: The global **opacity monitoring** market size is projected at a **CAGR** of **4.6%** during period of **2023-2031**.

Intellectual Property

IITM IDF Ref.:1807; **Patent No.**389506
PCT Application No. PCT/IN2020/050035

TRL (Technology Readiness Level)

TRL-4/5, Proof of Concept, Tested & Validated

Research Lab

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Technology

- Present invention describes an **online device** for optically measuring **fly ash** particulate in **industrial** stack **emissions** independent of moisture. **Figure 1** depicts the stack & systems for optical measurement, gravimetric sampling, aerosol feeding & data acquisition respectively.

Technology- Online Device

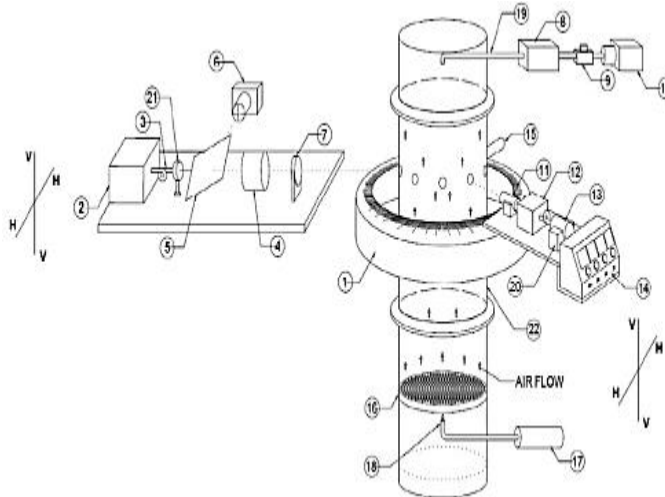


Fig.1: Illustrates a graphical representation of the online device.

Said **online device** comprises:

1. A Light source as a green laser

•For measuring the polarization resolved intensity of fly ash

2. A polarization resolved measuring technique

•To monitor PM emissions in wet industrial stacks;

- Further, the **depolarization** of horizontally polarized incident light **observed and quantified for fly ash & water aerosol complete depolarization** was observed for **fly ash at the 170° back-scatter angle**, while **water droplets** retained the **incident state**.

CONTACT US

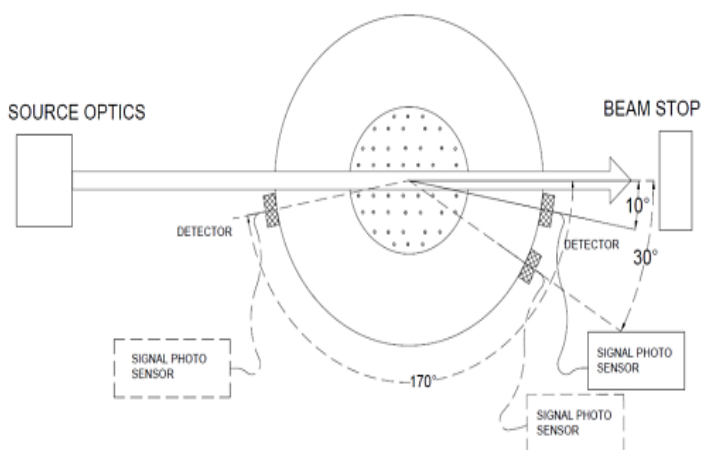
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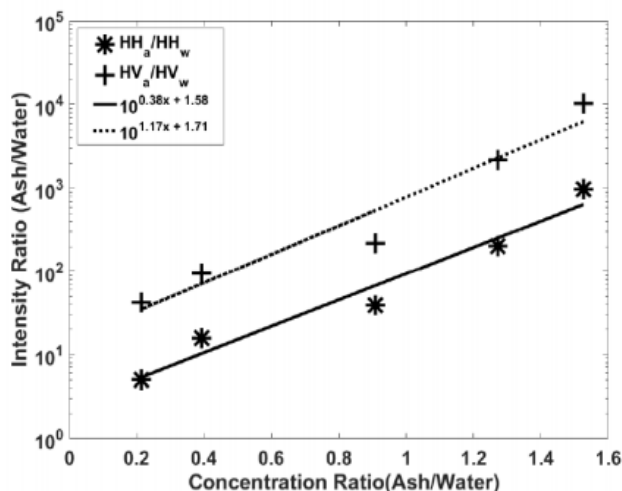
Image of Online Device during operation

Fig.2 : Illustrates optical configuration in the online device online for optically measuring fly ash particulate in industrial stack emissions independent of carryover moisture;



Outcome of proposed Device

Fig.3 : Illustrates the intensity ratio vs. loading rate ratio (fly ash: water droplets) depicting the importance of the 170° back-scatter 5 angle in resolving;



Key Features / Value Proposition

❖ Technical Perspective:

- The optical device comprises **16 apertures for detection** and **2 apertures for laser to pass through the aerosol medium & then to light trap.**
- There is a component of **IRIS** for receiving the beam going towards the measurement section with an aperture of diameter **0.5 mm** to **reduce intensity variations.**
- Further **condensing lens (f = 12 mm)** for collecting the scattered signal that passes through the polarizer and coupled to a photo multiplier tube (**PMT**) using the optical fiber.
- The **optical fiber** coupling the scattered signal to the PMT was connected to a **Wave Runner 6100A oscilloscope** for sampling the scattered signal from the particles at **1 MHz per channel & the amplitude** was averaged over the duration of pulse (**1s**) to **reduce the effect of random noise.** (Refer Fig. 2)
- The **measurements** were conducted for **1 MHz, 10 MHz & 25 MHz sampling rates** & an acceptable signal to noise ratio (**SNR**) obtained above **1 MHz sampling rate.** (Refer Fig. 3)
- The **photo multiplier tube (PMT) output** was averaged over the entire signal pulse above the threshold where the **threshold** defined as $\mu + 3\sigma$ of the reference signal recorded with the flow without the water aerosol.

❖ Industrial Perspective:

- **Cost-effective & eco-friendly** device & applicable for **low dust loading applications.**

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