Forget the School, Use the Tool

The Digital Opacity Compliance System
Third Generation (DOCS III):

USEPA Alternative Method 082

Visible Emission Management

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World Bank Requires, <20% Opacity Guarantee for Payment
ASTM D7520-16, used by World Bank: Opacity Measurement
Thousands of Projects, located in nearly every country
% Opacity is the
Nuisance Emission Measurement Indicator.
Opacity Monitoring History

• 1800-1974 – Opacity used to optimize combustion sources and determine the nuisance level of air emissions
  – 1970 EPA Published NAAQS, and national Opacity measure
  – 1971 EPA proposes 10% Opacity limit on Portland Cement

• 1975 to 2000 – Reference Method 9 is written into the vast majority of Clean Air Agency Regulations, City and County Ordnances throughout the US and developing countries and the measurement to the Maximum Visible Emission Allowed.

• 2007 - ASTM Workgroup to meet Technology Transfer Act requirement for EPA to use consensus standards, Creates the Digital Camera Opacity Technique D7520
  • 2009 - ASTM D7520-09 approved and published

• 2012 February – EPA Office of Air Quality Planning and Standards published US EPA Alternate Method 082 (ALT 082), Broadly Applicable Standard:
  – Digital Camera Opacity Techniques (DCOTs) can be used “in lieu of Method 9”, for all subparts of 40 CFR 60, 61 and 63

US EPA ALT 082 Broadly Applicable Standard
Most Credible Evidence Today
Opacity can be used by All Enforcement Agencies in US to act, against a pollution source.
Evolution of DOCS III Continued

- 2012 to Present – Fugitive Dust Applicability
  - Applicable to fugitives per 40 CFR 60 Subpart ooooa October 2012
- 2015- EPA opinion “Any Creditable Evidence” rule of Clean Air Act, DCOT Most Credible
  - Applicable to all Source types “a picture says a thousand words”.
- 2015- FerroAlloy NESAP defines DCOT as BACT, and mandates for Process Fugitive Emis.
- 2016 – ASTM D7520-16 Approved Applicable to all Opacity Sources
  - Digital Camera Opacity Technique (DCOT) Applicable
  - Stationary, Mobile, Fugitive
- 2017 – FerroAlloy NESHAP final reconsideration ruling DCOT is BACT for Opacity.
- 2018 – DOCS II Flare Watch Development begins expanded background, auto detect
- 2019 – DOCS II Heavy Diesel Inspection and Maintenance Full Speed Opacity Monitoring
- 2020 – Auto-Detect released to production clients for Flare Watch and HD Diesel ID
- 2020 – Heavy Diesel Inspection and Maintenance Toll Integration

- 2021 – Community Monitoring and Educational Tools
- 2021 – Reflection/Refraction/Rayleigh/Mie, Scattering principles used to speciate Opacity into PM Concentration within the Plume.
- 2022 – Neighborhood Wide Area Scanning Opacity Monitor Reporting % Opacity and concentrations of PM <3, 3-9, >9
Opacity Based Monitoring

Regulatory Compliance, Community Conservation

Software As a Service

Observation Analysis

Observation Analysis

Onsite Observation Switch
Archive Storage

MPG/JPG VEE Process

MPG/JPG VEE Manage

Obs. Event Trans for Analysis

Community Monitoring Pollutant Tracing

Electronic Complaints

Electronic VEE Reports
DOCS II Community Empowerment

Neighborhood, Watch Monitor

Community Controlled

Independent third-Party Review

Capture

Remotely Controlled Geo Referenced w/Google/NOAA

Receive Validated Digital Report

Each Monitor Circular Scans for Opacity, ½ Mile Radius, to measure Opacity and its Speciated PM Concentration

Review Submit Emission Events

30% Opacity
PM < 3m @ 20%
PM 3-9m @ 35%
PM > 9m @ 45%
VOC Present
How DOCS III Works

- An image or images of the emission source are captured by a Certified Camera Operator, credential for the Neighborhood watch, 6th Grade Class
- The images are uploaded to the “Cloud” where they are acquired by a Certified Analyst who identifies the Regions of Interest Credential for High School Graduation
- DOCS II then applies algorithms to the Regions of Interest and calculates the opacity of each image and the average, based on the selected rule, e.g. 6 min. avg., 3 min. avg.
- Opacity calculated is then converted speciated PM
- DOCS II generates a VEE report with speciated PM
- Data Owner accepts/rejects the draft VEE report
- DOCS II generates final VEE report and archive record with Opacity and Speciated PM

Inexpensive, Simple, Fast, Reliable, Repeatable

Uses Light Scatter Filters to find Opacity and PM

Water

PM >9=45
PM 3-9=35
PM <3=20
Community Air Protection Program

- Uses Promulgated Nuisance Emission Measure Opacity as base
  - Enables Regulators with actionable Information
  - Defines the Source and the PM emission.
  - Wide Area Scanning Line of Sight for 1 mile.
  - Scans Fence lines for Nuisance Emissions
  - Measures Distance to plume LiDAR embedded
  - Measures Temperature Plume
  - Day and Night
- Stationary Sources
  - Permitted with Opacity limits, require other compliance monitoring
  - Over 10,000 Stationary Sources monitored by DOCS
- Mobile Sources
  - Monitor for High Emitters at speed,
  - Vehicle Counts cars, trucks, trains, planes, ships
- Fugitive Area Sources
  - Larger sources farms and agriculture
  - Largest category of undocumented air pollution
  - Includes Wood Smoke and other unpermitted sources
- Natural Area Sources (spikes during event)
  - Great Dust Storm and Forest Fire Pictures
- Security and Surveillance Enabled
  - People/Animal detection
  - Automated perimeter search
Opacity/PM/VOC

Cameras Document Light Scatter humans can not see

Energy/Intensity Level, humans can not feel

Between Selected ROI’s

30 % Opacity

PM < 3m @ 20%
PM 3-9m @ 35%
PM > 9m @ 45%
VOC Present
Spot the Smoke Air Quality Complaint System
People Complain About What They See and Smell, Nuisance Emissions

- Load App
- Log In or Create an Account
- Submit to create a Draft Report
- Submit Draft for Opacity Analysis
- Receive Final Report

Take or Attach an Exiting Picture
Touch the Screen to Indicate Where you are looking

Building Community Air Monitoring Infrastructure
Flare Monitoring System with Opacity Event Reporting

- Convert to JPEG every 15 seconds during marked event times and display for observation cut down.

- Remote copy of MP4 "video files" to Cloud.
- Control Operators log, Mark Event times.
- Cuts MP4 into (1) JPG/15 seconds.
- Extracts JPG sets (Observations).
- Runs screening on Observations.
- Marks observations JPG w opacity.
- Generates Monthly and Semi Annual report.

Local Mounted Intrinsic all weather Internet Protocol Cam

- Local copy of MP4 “video files” mirrored to high-capacity drives, Archived monthly.
- Time marked by “Control Operators log” for events or detections against known backgrounds.
Heavy Duty Vehicle Emissions Enforcement

Convert to JPEG every 15 seconds during marked event times and display for observation cut down.

Remote copy of MPEG “video files” Plate/Transponder number tag to images. MP4 into JPG at set interval (reduce storage). Opacity Analysis on high image (smoke > 5%) Creates Violation Record (Image, Opacity, Plate/Trans). Transmits Violation record to ??? for enforcement. Automated Enforcement Close out. Generates monthly follow up report.