

Environmental Engineering and Air Pollution Control

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What is environmental engineering?

The application of science and engineering principles to:

- Improve the environment (air, water, and land resources).
- Provide healthy air, water, and land for people and other organisms.
- Remediate polluted water and land.

Air Pollution



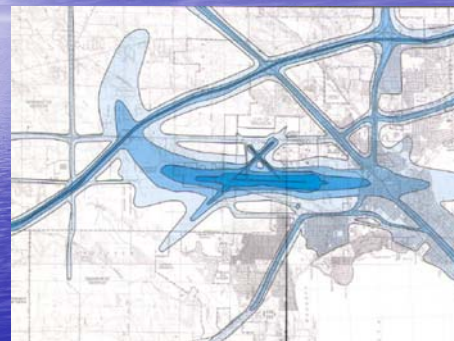
Air Pollution Control



Noise Pollution



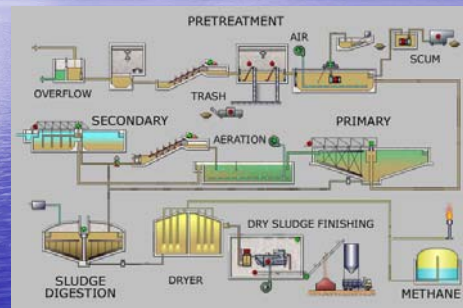
Noise Pollution Control



Water Pollution



Water Pollution Control



Water Supply



Storm Water Runoff



Solids Waste Disposal



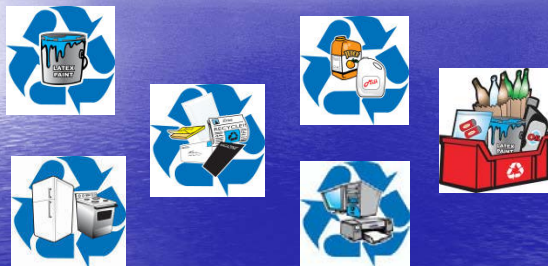
Hazardous Waste Disposal



Pollution Prevention



Recycling



Environmental Engineering Topics

- Air Pollution Control
- Noise Pollution Control
- Water Pollution Control
- Water Supply
- Storm Water and Runoff Management
- Solid, Hazardous and Infectious Waste Management
- Pollution Prevention
- Recycling
- Industrial Hygiene and Occupational Health
- Public Health
- Laws and Regulations
- Project or Facility Environmental Impacts

Potential Professions

You can be a:

- Designer
- Planner
- Researcher
- Operator of pollution control facilities
- Professor
- Government regulatory agency official
- Manager of programs

Potential Employers

- Private consulting firms
- Universities
- Private research firms
- Testing laboratories
- Government agencies
- Manufacturing businesses
- Private businesses

Where do you work?

- Inside at a desk.
- Inside at a busy factory.
- Outside at a job site.
- In a remote location.
- Up on a roof or stack.
- In a trench, tunnel or sewer.
- Around the world in person or on the internet.
- Everywhere.

Required Training

- B.S. degree in engineering --- civil, chemical, mechanical or environmental
- M.S. - Ph.D. in environmental engineering
- Post-graduate training courses.
- Professional conferences.
- Professional Engineering License (EE P.E.)
- Certifications (CHMM, BCEE, ...)

P.E. Principles & Practice Exam

- Wastewater
- Stormwater
- Potable Water
- Water Resources
- Ambient Air
- Sources of Air Pollution
- Emission Control Strategies
- Municipal Solid Waste
- Commercial and Industrial Wastes
- Hazardous Waste, Special, and Radioactive Waste
- Environmental Assessments
- Remediation
- Public Health and Safety

Professional Organizations

- Air & Waste Management Association
- American Academy of Environmental Engineers
- American Society of Civil, Mechanical or Chemical Engineers
- Pollution Control Societies

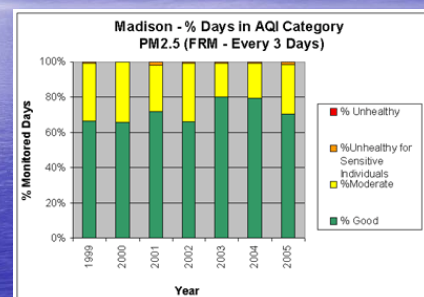
Principles and Practice of Air Pollution Control

- History of Air Pollution Control
- Health and Environmental Effects of Air Pollution
- Transport and Dispersion of Air Pollutants
- Air Quality Management
- Ambient Air Quality Monitoring
- Measurement of Emissions from Stationary Sources
- Emission Inventories
- Laws and Regulations
- Control of Emissions from Stationary Sources
- Control of Emissions from Mobile Sources
- Pollution Prevention
- Compliance Monitoring and Enforcement
- Indoor Air

Ambient Monitoring



Historic Trends for Fine Particles (PM2.5)



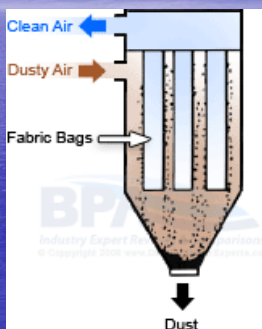
Stack & Emission Testing



Control Methods for Dust: Filters & Baghouses



Control Methods – Baghouse



Filter and Baghouse Design

Shape: Sheet, Cartridge and Bags
Fabric: Polyester, Nylon, Teflon, Gore-tex
Cleaning Method: Shaker, Reverse Air, Pulse-Jet
Air to Cloth Ratio:
= ft^3 per minute flow rate / ft^2 filter cloth area
= 7:1 for pulse jet type
Cost: \$6 to 39 per ft^3 per minute flow rate

1.3 Million CFM Baghouses



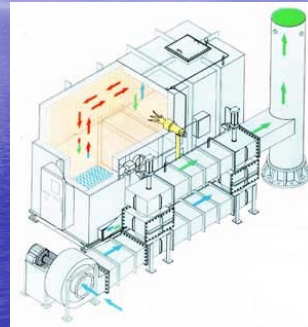
Control Method for Gaseous Organic Compounds: Incineration



Regenerative Incineration



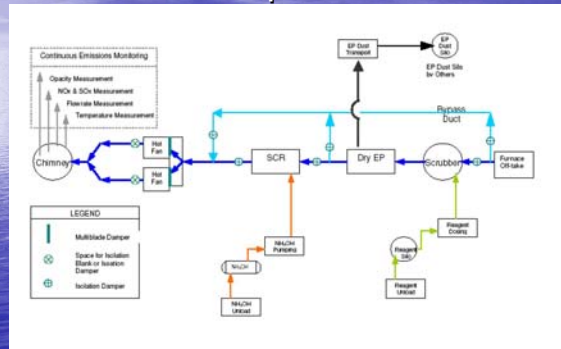
Regenerative Incineration



Incineration Design

- Recuperative, Catalytic, Regenerative
- Size and Cost Proportional to Flow Rate
- Energy Recovery: 70 to 99%
- Temperature: 600 to 1,400+ degrees F
- Pollutant Destruction: 90 – 99%+
- Cost: \$8 to 33 per ft³ per minute flow rate

Control of Multiple Pollutants



Control of Fugitive Coal Dust



Dane County Air Pollution

Air Pollution Source	Carbon Monoxide	Nitrogen Oxides	PM _{2.5}	PM ₁₀	Sulfur Dioxide	Volatile Organic Compounds
Mobile	86%	75%	32%	32%	15%	52%
Area	6%	17%	48%	54%	29%	41%
Point	8%	8%	20%	14%	56%	8%
Total (TPY)	151,122	27,223	8,018	27,286	10,164	24,938

Pollutant Control Requirements

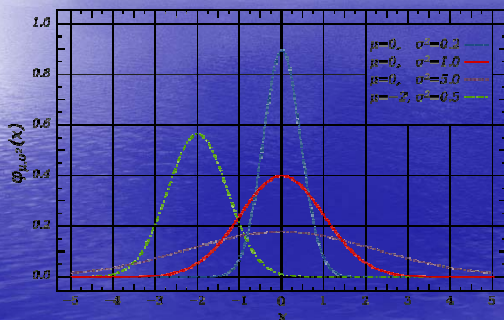
- 1 – Comply with emission standards by using control methods.
- 2 – Comply with health standards by using computer dispersion modeling.

Dispersion

“the solution to pollution is dilution”

Computer Dispersion Models

- Gaussian (normal) distribution

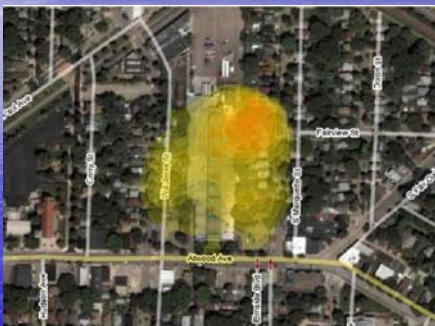


Gaussian distribution

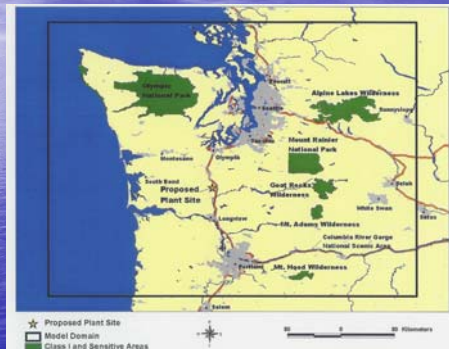
- Highest concentration is the center of the plume at ground level:

$$= Q / 2 \Pi u \sigma_y \sigma_z$$
 Where:
 Q = Air Pollutant Emission Rate
 U = Hourly Wind Speed
 $\sigma_y \sigma_z$ = Vary with Weather Conditions
- Pollutant moves the same direction as the first hour.

Predicting Air Pollutant Dispersion



Non-Gaussian Puff Models



Air Quality and Emission Standards

- Federal Clean Air Act (USEPA)
www.epa.gov
- State Statutes and Rules (WDNR)
www.dnr.state.wi.us
- Local Ordinances (Other States)

Daily Pollution Control Activities

- Continuous monitoring of stack emissions and pollution control equipment.
- Periodic tests.
- Recordkeeping and Reports.
- Inspections.

