INDUSTRIAL VENTILATION AND SYSTEM TROUBLESHOOTING
Industrial Ventilation, Putting the Pieces Together
Industrial Ventilation

• First Edition of the *Industrial Ventilation Manual* was published in 1951.
• It has been the primary resource for engineers and industrial hygienists to design and evaluate industrial ventilation systems
• The primary purpose of the manual is to protect worker health through good practices in industrial ventilation
  • There is a direct Carolinas AIHA relationship:
    Warren Cook
    Marion Trice
    John Lumsden
The North Carolina Ventilation Conference is in its 54 year
It was started in 1958

Founders:
John Lumsden - NC State Board of Health
Richard Knight - Mechanical Engineering, NCSU
Dave Fraser - School of Public Health, UNC-CH
Emil Chanlett – School of Public Health, UNC-CH
Ventilation in the Workplace

There are three types of workplace ventilation:

- "Indoor air quality ventilation" used primarily to provide fresh, heated or cooled air to buildings as part of the heating, ventilating and air-conditioning system (HVAC)

- "Dilution ventilation" which dilutes contaminated air in a whole building or room by blowing in clean air and exhausting some dirty air

- "Local exhaust ventilation" which captures contaminate emissions at or very near the source and exhausts them outside.
Dilution Ventilation is Appropriate When:

- Emission sources contain materials of relatively low hazard;
- Emission sources are primarily vapors or gases;
- Emissions occur uniformly;
- Emissions are widely dispersed;
- Moderate climatic conditions prevail;
- Heat is to be removed from the space by flushing it with outside air;
- Portable or mobile emission sources are to be controlled
DILUTION VENTILATION

Advantages

- Usually lower equipment and installation costs.
- Requires less maintenance.
- Effective control for small amounts of low toxicity chemicals.
- Effective control for flammable or combustible gases or vapors.
- Best ventilation for mobile sources.
DILUTION VENTILATION

Disadvantages

• Does not completely remove contaminants.
• Cannot be used for highly toxic chemicals.
• Ineffective for large amounts of dusts, fumes, gases or vapors.
• Requires large amounts of heated or cooled makeup air.
• Ineffective for handling surges of gases or vapors or irregular emissions.
Local Exhaust Ventilation is Appropriate When:

• Emission sources contain materials of relatively high hazard;
• Emissions vary over time;
• Emission sources consist of point sources;
• Employees work in the immediate vicinity of the emission source;
• The plant is located in a severe climate;
• Minimizing air turnover is necessary.
LOCAL EXHAUST VENTILATION

Advantages

• Captures contaminant at source and removes it from the workplace.
• Only choice for highly toxic airborne chemicals.
• Can handle all sorts of contaminants (dusts, fumes, gases and vapors).
• Requires smaller amount of makeup air since smaller amounts of air are being exhausted.
• Less energy costs since less makeup air to heat or cool.
LOCAL EXHAUST VENTILATION

Disadvantages

• Higher cost for design, installation and equipment
• Requires regular cleaning, inspection and maintenance
Comparison of Exhaust Fans and Air Inlets

POOR air inlet POOR exhaust

FAIR air inlet BEST exhaust
Comparison of Exhaust Fans and Air Inlets

- BETTER air inlet
- BEST exhaust

- Exhaust Fan
- Makeup Air Fan

- Exhaust Fan
- Makeup Air Fan

- Exhaust Fan
- Makeup Air Fan

- Exhaust Fan
- Makeup Air Fan
Air Inlet and Exhaust Fan
Best Situation Design

Replacement air supplied through perforated duct and perforated plate.

Velocity through open area of perforate plate:
\[ V = 5.1 \text{m/s} \] (1000 fpm)

Differential pressure gauge range:
-4.97 Pa (0.02 in. w.g.)
to
-14.9 Pa (0.06 in. w.g.)

Work space is sealed including doors and windows.
Local Exhaust Ventilation

• Local exhaust ventilation operates on the principle that air moves from an area of high pressure to an area of low pressure.

• The difference in low pressure is created by a fan that draws air through the ventilation system.

• Local exhaust systems are located as close as possible to the source of the contaminant.

• The worker and their work must be considered in designing a system.
Local Exhaust Ventilation Systems

• A local exhaust system has five basic components:
  – A hood or opening that captures the contaminant at the source,
  – Ducts that transport the airborne chemicals through the system,
  – An air cleaning device (not always required) that removes the contaminant from the moving air in the system,
  – A fan that moves the air through the system and discharges (blows) it outdoors,
  – An exhaust stack through which the contaminated air is discharged.
Local Exhaust Ventilation Systems
The remainder of this course will provide you with a fundamental understanding of the components of a local exhaust ventilation system, basic design concepts and system evaluation principles.