Tipe / Jenis Ventilasi Industri

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AGENDA PEMBAHASAN

Tipe / Jenis Ventilasi Industri

- General dilution ventilation
- Local exhaust ventilation
- Heating, ventilation and air conditioning system (HVAC)
Generalized Diagram: Methods of Control

Desired control priority for chemical hazards

1. Source control
2. Pathway control
3. Receiver control
Ventilation is a *primary engineering control* available to eliminate or reduce the concentration of gases, dusts, vapors, smoke, and fumes present in the work environment.

Ventilation is defined as the process of supplying air to, or removing air from, any space by *natural* or *mechanical* means.
Types of Ventilation

1. General Dilution Ventilation *(Pathway control)*
   - Mechanical Ventilation *(involves Fans)*
   - Natural Ventilation *(with natural air movement caused by thermal gradient or any other)*

2. Local Exhaust Ventilation *(Source control)*

3. Heating Ventilation and Air conditioning System *(to control temp. & humidity)*
1. "Dilution (general) ventilation/Ventilasi Pengenceran Udara", pengenceran terhadap udara yang terkontaminasi di dalam bangunan atau ruangan, dengan bertiup udara bersih (tidak tercemar) yang bertujuan untuk mengendalikan bahaya di tempat kerja.

2. "Local exhaust ventilation/Ventilasi pengeluaran setempat" , adalah proses pengisapan dan pengeluaran udara terkontaminasi secara serentak dari sumber pencemaran sebelum udara berkontaminasi berda pada ketinggian zona pernapasan dan menyebar keseluruh ruang kerja, umummnya ventilasi jenis ini di temapatkan sangat dekat dengan sumber emisi

3. "Indoor air quality ventilation" digunakan terutama untuk memberikan udara segar, atau didinginkan / udara dipanaskan untuk bangunan sebagai bagian dari pemanasan, ventilasi dan sistem pendingin udara,
1. DILUTION (general) VENTILATION/
Ventilasi Pengenceran Udara

- Dilusi ventilasi biasanya dicapai dengan cara mengencerkan udara yang terkontaminasi atau mengandung gas yang mudah terbakar dengan meniupkan udara ketempat kerja dan mengeluarkan kembali.
- Aliran udara harus diperhitungkan dalam desain gedung
Clean Air Supply

Zone of Contaminant Release

Operators Breathing Zone

Discharge Opening

Clean Air Supply

Direction of air flow must remove contaminants from workers breathing zone
Figure 20–1. Dilution ventilation gradually removes contaminants dispersed in the workroom air.
Recommended Practices

BEST air inlet
BEST exhaust

BEST air inlet
BEST exhaust

UNACCEPTABLE air inlet and exhaust
Example of General Dilution Ventilation?

General Ventilation System KemJet

In use at:
Holland Lift International bv, Hoorn - Niederlande
General Dilution Ventilation

- If (TLV <100ppm)- not recommended
- Only suitable for contaminant with low & uniform generation rate
- Not completely remove the contaminant
- Some general ventilation devices:---

Roof-mounted exhaust fans

Industrial exhaust fans
General or Dilution Ventilation Type

Natural Ventilation

Mechanical Ventilation

Preferred if significant health hazards exist
SYSTEM OF VENTILATION – Natural

- Definition - the process of supplying and removing air through an indoor space without using mechanical systems. It refers to the flow of external air to an indoor space as a result of pressure or temperature differences.
- The benefits of natural ventilation include:
  1. Improved Indoor air quality (IAQ)
  2. Energy savings
  3. Reduction of greenhouse gas emissions
  4. Reduction in occupant illness associated with Sick Building Syndrome
  5. Increased worker productivity
• How can you relate the natural ventilation with this criteria:

1- Indoor Air Quality
2- Energy saving
3- Sick Building Syndrome

DURATION: 10 minutes

DISCUSSION 1
Recommendations from design guidelines from various building regulations suggest the following:

1. Building orientation and location.
2. Building form and dimensions.
3. Window typologies and operations;
4. Types, shape and size of openings;
5. Construction methods and detailing;
6. Urban planning consideration
SYSTEM OF VENTILATION - Mechanical

• Definition - mechanical ventilation systems circulate fresh air using **ducts and fans** rather than relying on airflow through small holes or crack’s in a home’s wall, roof or windows. Homeowners can breathe easier knowing their home has a good ventilation.

• Benefits of using mechanical ventilation:-

1. **Better indoor air quality** – can remove pollutants, allergens, and moisture that can cause mold problems

2. More control – **provide proper fresh air flow** along with appropriate locations for intake and exhaust

3. Improved **comfort** – allow a constant flow of outside air into the home and can also provide filtration, dehumidification, and conditioning of the incoming outside air.
SYSTEM OF VENTILATION - Mechanical

- These systems employ an electrically driven fan or fans to provide the necessary air movement;
- They also ensure a specified air change and the air under fan pressure can be forced through filters. There are three types of mechanical ventilation systems:
  1. Natural inlet and mechanical extract (exhaust system).
  2. Mechanical inlet and natural extract
  3. Mechanical inlet and extract
• This is the most **common type** of system and is used for **kitchens, workshops, laboratories, internal sanitary apartments, garages and assembly halls**.

• The **fan creates negative pressure on its inlet side**, and this causes the air inside the room to move towards the fan, and the room air is displaced by the fresh air from outside the room.
MECHANICAL INLET & NATURAL EXTRACT

• It is essential with this system that the air is heated before it is forced into the building.
• The system may be used for boiler rooms, offices and certain types of factories.
• The air may be heated in a central plant and ducted to the various rooms, or a unit fan convector may be used.
MECHANICAL INLET & EXTRACT

• This provides the best possible system of ventilation, but it is also the most expensive and is used for many types of buildings including cinemas, theatres, offices, lecture theatres, dance halls, restaurants, departmental stores and sports centers. The system is essential for operating theatres and sterilizing rooms.
Keterbatasan Dilution (general) ventilation/Ventilasi Pengenceran Udara

- Tidak sepenuhnya menghapus kontaminan.
- Tidak bisa digunakan untuk bahan kimia sangat beracun.
- Tidak efektif untuk debu atau uap logam atau sejumlah besar gas atau uap.
- Memerlukan jumlah besar makeup udara yang akan dipanaskan atau didinginkan.
- Apakah tidak efektif untuk menangani uap atau emisi tidak teratur
2. LOCAL EXHAUST VENTILATION / Ventilasi Pengeluaran Setempat (Source Control)

Tujuan dari sistem ini adalah mengeluarkan udara kontaminan bahan kimia dari sumber tanpa memberikan kesempatan kontaminan mengalami difusi dengan udara di tempat kerja.

• Capture or contain contaminants at their source
• **Hoods** - any point where air is drawn into the ventilation system to **capture** or control **contaminants**.

• **Ducts** - the **network of piping** that connects the hoods and other system components.

• **Fan** - air-moving device that **provides the energy** to draw air and contaminants into the exhaust system & through the ducts and other components.

• **Air Cleaner** - a device to **remove airborne materials** that may be needed before the exhaust air is discharged into the community environment.
Gambar, Contoh cara ventilasi pengeluaran setempat. Sebelah kiri kontaminan ditarik melalui meja kerja sebelum mencapai zona pernapasan si pekerja. Sebelah kanan asap dari pengelasan ditarik kedalam sistem pembuangan udara.
MODEL VENTILASI PENGETELUARAN SETEMPAT
Local Exhaust Ventilation (LEV) systems
What is Local Exhaust Ventilation?
Capture Velocity - Air velocity at any point in front of the hood necessary to overcome opposing air currents and to capture the contaminant at that point causing it to flow into the hood

- Important hood/process design criteria

Face velocity
Air velocity at the hood or slot opening
Effect of Side Baffles

Figure 1. Hood Capture Velocities Near a Hood

Figure 3. Beneficial Effect of Side Baffles on Hood Capture Velocities

Legend:
- ~100.0%
- ~60.0%
- ~30.0%
- ~15.0%
- ~7.5%
Use of Enclosures

- Increased power consumption
- Less collection efficiency
- Increased flow rate to have sufficient capture velocity

- More collection efficiency
- Less flow rate required
- Less power consumption
Benefits of ENCLOSURES

• Using techniques such as enclosures, control capabilities are maximized

• Air volumes requirements are drastically minimized

• Reduces required make-up air and associated costs
Direction of Air Movement

Bad

Good
## Selection of capture velocity

<table>
<thead>
<tr>
<th>Dispersion of Contaminant</th>
<th>Examples</th>
<th>Capture Velocity, ft/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Released with practically no velocity into quiet air.</td>
<td>Evaporation from tank; degreasing.</td>
<td>50–100</td>
</tr>
<tr>
<td>Released at low velocity into moderately still air.</td>
<td>Spray booths; intermittent container filling; low-speed conveyor transfers; welding; plating; pickling.</td>
<td>100–200</td>
</tr>
<tr>
<td>Active generation into zone of rapid air motion.</td>
<td>Spray painting in shallow booths; barrel filling; conveyor loading; crushers.</td>
<td>200–500</td>
</tr>
<tr>
<td>Released at high initial velocity into zone of very rapid air motion.</td>
<td>Grinding; abrasive blasting; tumbling.</td>
<td>500–2000</td>
</tr>
</tbody>
</table>

*In each category above, a range of capture velocities is shown. The proper choice of values depends on several factors:*

<table>
<thead>
<tr>
<th>Lower End of Range</th>
<th>Upper End of Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Room air currents minimal or favorable to capture.</td>
<td>1. Disturbing room air currents.</td>
</tr>
<tr>
<td>2. Contaminants low toxicity or of nuisance value only.</td>
<td>2. Contaminants of high toxicity.</td>
</tr>
<tr>
<td>3. Intermittent, low production.</td>
<td>3. High production, heavy use.</td>
</tr>
<tr>
<td>4. Large hood-large air mass in motion.</td>
<td>4. Small hood-local control only.</td>
</tr>
</tbody>
</table>

FANS

- **Propeller Fan**

Does not create much air pressure and has limited effect in ductwork. Ideal for use at air openings in windows and walls.
FANS
- Axial Flow Fan
  can develop high pressure and is used for moving air through long sections of ductwork. The fan is integral with the run of ducting and does not require a base.
FANS
- Centrifugal Fan

can produce high pressure and has the capacity for large volumes of air. Most suited to larger installations such as air conditioning systems. It may have one or two inlets. Various forms of impeller can be selected depending on the air condition. Variable impellers and pulley ratios from the detached drive motor make this the most versatile of fans.
**CELL OR PANEL TYPE**

- Flat or in a vee formation to increase the surface contact area.
- Available in dry or wet (viscous) composition in disposable format for simple fitting within the ductwork. A rigid outer frame is necessary to prevent flanking leakage of dirty air.
- Dry filters can be vacuum cleaned to extend their life, but in time will be replaced. The viscous filter is coated with an odorless, non-toxic, non-flammable oil. These can be cleaned in hot soapy water and recoated with oil.

**AIR FILTERS**
BAG TYPE

• A form of filtration material providing a large air contact area.
• When the fan is inactive the bag will hang limply unless wire reinforced.
• It will resume a horizontal profile during normal system operation.
• Fabric bags can be washed periodically and replaced.

AIR FILTERS
ROLLE TYPE FILTER

• Operated manually or by pressure sensitive switch.
• As the filter becomes less efficient, resistance to air flow increases.
• The pressure effects a detector which engages a motor to bring down clean fabric from the top spool.
• Several perforated rollers can be used to vee format and increase the fabric contact area.

AIR FILTERS
VISCOUS TYPE FILTER

• These have a high dust retention capacity and are often specified for application to industrial situations.

• An improvement on the panel type has close spaced corrugated metal plates continuously sprayed with oil. A rotating variation has filter plates hung from chains.

• The lower plates in the cycle pass through a bath of oil which removes attached particles and resurfaces the plates with clean oil.
**ELECTROSTATIC UNIT TYPE**

- This has an ionising area which gives suspended dust particles a positive electrostatic charge.
- These are conveyed in the air stream through metal plates which are alternately charged positive and earthed negative.
- Positively charged particles are repelled by the positive plates and attracted to the negative plates.
- The negative plates can also be coated with a thin layer of oil or gel for greater retention of dust.
- The unit can have supplementary, preliminary and final filters as shown below, giving an overall efficiency of about 99%.

**AIR FILTERS**
LEV system is usually preferred control method, if:

- Air contaminants pose **serious health risk**.
- Large amounts of dusts or fumes are generated.
- Increased heating costs from ventilation in cold weather are a concern.
- Emission sources are near the workers' breathing zones.
kontaminan udara menimbulkan risiko kesehatan yang serius.

jumlah besar debu atau asap yang dihasilkan.

Peningkatan biaya pemanasan dari ventilasi dalam cuaca dingin sering dilakukan.

Emisi sumber sedikit jumlahnya.

Emisi sumber yang dekat dengan zona pekerja 'bernapas'
<table>
<thead>
<tr>
<th><strong>Dilution (general) ventilation/Ventilasi Pengenceran Udara</strong></th>
<th><strong>Local exhaust ventilation/Ventilasi pengeluaran setempat</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Keuntungan</strong></td>
<td><strong>Kekurangan</strong></td>
</tr>
<tr>
<td>Biasanya biaya peralatan dan instalasi, lebih rendah</td>
<td>Tidak sepenuhnya menghilangkan udara yang berkontaminan.</td>
</tr>
<tr>
<td>Tidak membutuhkan perawatan yang spesifik/rutin</td>
<td>Tidak bisa digunakan untuk bahan kimia sangat beracun.</td>
</tr>
<tr>
<td>Efektif untuk mengontrol jumlah kecil bahan kimia toksisitas rendah.</td>
<td>Tidak efektif untuk debu atau uap logam atau sejumlah besar gas atau uap.</td>
</tr>
<tr>
<td>Efektif mengontrol gas atau uap yang mudah terbakar.</td>
<td>Membutuhkan sejumlah besar makeup udara panas atau dingin</td>
</tr>
<tr>
<td>Untuk sumber kontaminan yang tersebar, atau mobile</td>
<td>Tidak efektif untuk menangani, gas, atau uap, atau emisi tidak teratur</td>
</tr>
</tbody>
</table>

What is HVAC?
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Selanjutnya