Penentapan konsentrasi debu

Penentapan konsentrasi debu (C) dalam udara untuk yang bekerja 8 jam/hari, 40 jam/minggu adalah:

\[
C = \frac{2,5 \times 20}{100} = 0.5 \text{ mppcf}
\]

Prevention

- Pneumoconiosis can be prevented by enforcing maximum allowable dust levels in mines and at other work sites, and by using protective masks.
- Regular medical examinations, including chest x-rays for people at risk, can detect pneumoconiosis during its earlier stages, before it becomes disabling.

Treatment...

The only treatment is to avoid smoking and further exposure to dust, and to treat complications.
General Methods of Control

- Substitution of a less harmful material for one which is dangerous to health
- Change or alteration of a process to minimize worker contact
- Isolation or enclosure of a process or work operations such as mining and quarrying
- Local exhaust at the point of generation or dispersion of contaminant
- General or dilution ventilation with clean air to provide a safe atmosphere
- Personal Protective devices, such as special clothing or eye and respiratory protective

Substitution

- Replacement of a toxic material with a harmless one
- Substitution of solvent
  - Experiment on a small scale before making the new solvent part of the operation or process
  - Carbon tetrachloride → methyl chloroform, dichloromethane, aliphatic petroleum hydrocarbons.
  - Benzene → toluene (paint remover)
  - Foundries using parting compounds that contain free silica (minimize silicosis)

Changing the process

- Often offers an ideal chance to improve working condition
- Changes are made to improve quality or reduce cost of production only occasionally to improve the in-plant environment

Examples

- Automobile industry
  - The amount of lead dust created by grinding solder
    - Small, rotary, high speed sanding disk → low speed, oscillating-type sanders
  - Brush painting or dipping instead of spray painting will minimize the concentration of airborne contaminants from toxic pigments
  - Arc welding in place in place of riveting, vapor degreasing with adequate controls to replace hand-washing of parts in open container

Examples

- Airless spraying techniques and electrostatic devices to minimize overspray as replacements for hand-spraying
- Machine application of lead oxide to battery grids which reduced lead exposure to operators in making storage batteries
- Before purchase the new machine, should be considered:
  - Ventilation
  - Vibration
  - Heat control
Isolation or Enclosure

- Some potentially dangerous operations can be isolated from the people nearby, which solves the exposure problem
  - Physical barrier
  - By time (semi-automatic equipment)
  - By distance (remote control)
- Enclosure will prevent or minimize the escape of solvent vapor into the workroom atmosphere
- Where highly toxic solvents are used, enclosure should be one of the first measures attempted after considering substitution.

Examples

- Shipbuilding: using dry sand
  - Isolate the process
  - Off-shift: few employees, should wear an air supplied respirator
- Radium dial painting, gloves booths
- Airless blast or shoot blast machines for cleaning castings, and abrasive blasting cabinets
- In chemical industry: using closed system
- Mechanical industries: complete enclosure
  → From sand blasting or metal spraying operations

Isolation & enclosure

Wet methods

Dust hazards can frequently be minimized or greatly reduced by application of water or other suitable liquid at the source of dust

Simplest methods for dust control. Its effectiveness, however, depends upon proper wetting of the dust

Examples: rock drilling operation, foundries → sandblasting

Kelembaban udara dengan NAB sekitar 75% dapat mengurangi jumlah debu di udara

Local Exhaust Ventilation

- A local exhaust system traps the air contaminant near its source so that a worker standing at the process is not exposed to harmful concentrations
- Should be used when the contaminant cannot be controlled by substitution, changing the process, or isolation or enclosure

Its performance should be checked

- Correct rates of air flow
- Duct velocities
- Negative pressures
- The others
A Local exhaust system consists of four parts:

- **Hood**: the airborne contaminant is drawn
- **Ducts**: carrying the contaminated air to a central point
- **An air-cleaning devices**: a dust arrestor for purifying the air before it is discharged
- **A fan**: create the required air flow through the system

Local exhaust system:

- **Duct**
  - Single duct, hanya melayani satu sumber pengotor
  - Multiple duct, bercabang

Principles of hood design...

- Enclose the operation as much as possible to reduce the rate of air flow needed to control the contaminant (Picture A)
- Always locate a hood so the contaminant is moved away from the breathing zone of the operator (Picture B)
- Locate and shape the hood so the initial velocity of the contaminant will throw it into the hood opening operator (Picture C)

- Solvent vapors in health-hazard concentration are not appreciably heavier than air. Capture them at their source rather than collect them at the floor level (Picture D)
- Locate the hood as close as possible to source of contaminant (Picture E)
- Design the hood so it will not interfere with the worker
The more completely the hood encloses the source, the less air is required for control in this straight-line automatic buffing operation.

The hood should be located so the contaminant is removed away from the breathing zone of the worker.

No protection from toxic fume.

The hood should be so located and shaped that the original velocity of the contaminant will throw it into the hood opening.

Exhaust from the floor usually gives fire protection only.

The required volume varies with the square of the distance from the source.
Perhitungan:

Kecepatan aliran udara dapat dihitung dengan rumus:

\[ v = \frac{Q}{A} = \frac{Q}{4X^2} \]

dimana \( X \) = jarak terhadap suatu titik dari mulut hood

\[ v = bQ/(X^2+bA) \]

dimana \( b = 0,1 \) untuk mulut hoods berbentuk lingkaran atau bujursangkar

Canopy Hood

Perkiraan jumlah udara yang diperlukan adalah dapat dihitung dengan rumus pendekatan:

\[ Q = 1,4 \times 2(L+W)H \times V \]

\( Q \) = rate of air flow (cfm)
\( L \) = tank length (ft)
\( W \) = tank width (ft)
\( H \) = height of canopy above tank (ft)
\( V \) = desired control velocity (fpm)

Air cleaner (Pembersih Udara)

- Kolektor sentrifugal: tunggal dan paralel
- Kolektor sentrifugal basah
- Electrostatic precipitator

Canopy Hood

Contoh:

- \( V \) suatu aliran udara pada duct yang berdiameter 6" adalah 4000 fpm beberapa pada jarak 2" dan 4"?

  - Untuk jarak 2", \( v \) adalah \( \frac{27,3}{4000} = 0,068 \) fpm
  - Untuk jarak 4", \( v \) adalah \( \frac{27,3}{4000} = 0,071 \) fpm
  - Jika \( X \) = diameter duct, rumus pendekatan adalah:

\[ v = \frac{Q}{10X^4} \]

Fan

- Penghisap berbentuk kipas yang digerakkan oleh motor listrik, ada 2 macam:
  - Sentrifugal, aliran udara bergerak mengelilingi sumbu kipas, baik untuk LEV, terdiri dari 2 macam:
    - Forward curved blades, efisiensi tinggi, bising
    - Forward curved blades, untuk beban yang rendah, silent.
  - Axial, aliran udara bergerak searah sumbu putaran kipas, baik untuk mengurangi kelembapan pada ventilasi umum (yang tidak mengandung partikel)
More local exhaust

Hoods and ducts

General ventilation

- Ventilasi umum (General ventilation), untuk sumber kontaminan yang tersebar dan tidak terlalu berbahaya
- Ventilasi umum = ventilasi dilusi
  - ada suplai dan ada udara dikeluarkan
- Penting diperhatikan lokasi udara masuk dan keluar terhadap posisi pekerja dan arah dispersi debu
Perlindungan perorangan (personal protection)

- Perlindungan perorangan (personal protection), berupa perlindungan pernafasan dengan masker, desain sebaik mungkin jika perlu diberi supply oksigen.
- APD: alat pelindung diri
- Untuk debu yang relevan adalah respirator, proteksi sistem pernapasan
- Kenyamanan penting agar pekerja mau pakai
- Jumlah debu tinggi, respirator harus digunakan, dan dipakai sesaat saja
- Kesulitan respirator adalah dalam memenuhi standar yang berlaku
Radiation mask

AIR PURIFYING
- Digunakan bila O2 cukup (16%) pada 1 atm
- Masa baku/useful-life
- Ada 3 macam:
  - Saringan mekanis: dari serat, untuk debu, asap, fumes, bentuk: half mask, full mask
    (bukan untuk gas)
  - Kimia (reaksi): berisi zat kimia yang dapat menetralisir zat kimia tertentu; konsentrasi kontaminan rendah (0,05-0,1 vol%)
    (BUKAN untuk: emergency, toxic gas → kombinasi mekanis dan kimia)
  - Gas: special gas, ada warna standar: CO= biru, HCN= putih hijau; organik= hitam; tidak ≥ 2 vol% toxic gas

Housekeeping
- Is always important
- Dust on the floor can readily be dispersed to the inplant atmosphere by traffic, vibration, and random air currents.

Ada Pertanyaan?