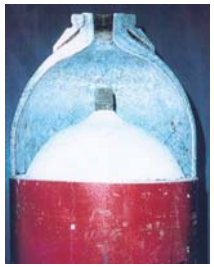
ACETYLENE GAS SAFETY SEMINAR 2009



Asia Industrial Gases Association

Council of Labor Affairs Executive Yuan

Taiwan High Pressure Gas Industrial Association

SAHTECH 財團法人 安全衛生技術中心

Safety & Health Technology Center

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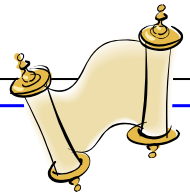
ACETYLENE PRODUCTION, PURIFICATION AND DRYING

Presented by

Vijay Kumar (Linde Gas Asia)

Overview

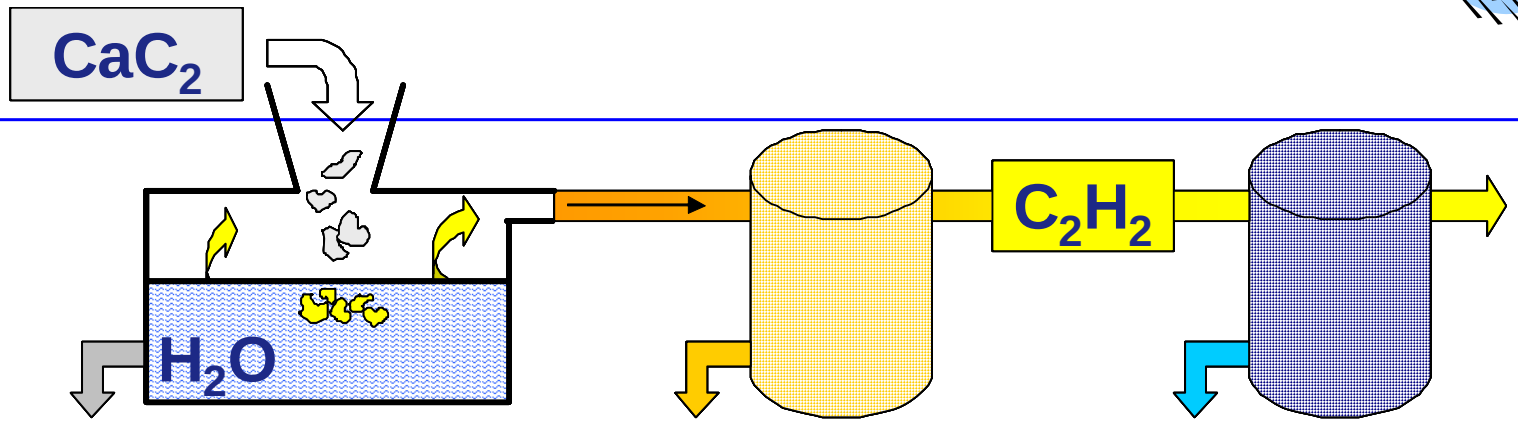


- Some facts
- Generators
- Purifiers
- Dryers
- Controls & Yield
- Incidents
- Conclusions & Outlook

Some facts – C_2H_2 production

- World production: 122 000 t (1998)
- Chemical production (80%)
  - Pyrolysis, cracking => chemical synthesis
    => production of rubber, plastics, resins
- "Wet" method production (20%)
  - Calcium carbide + Water => Acetylene
    => cutting and welding (cylinders)

“Wet” method



lime slurry | chemicals | water, oil

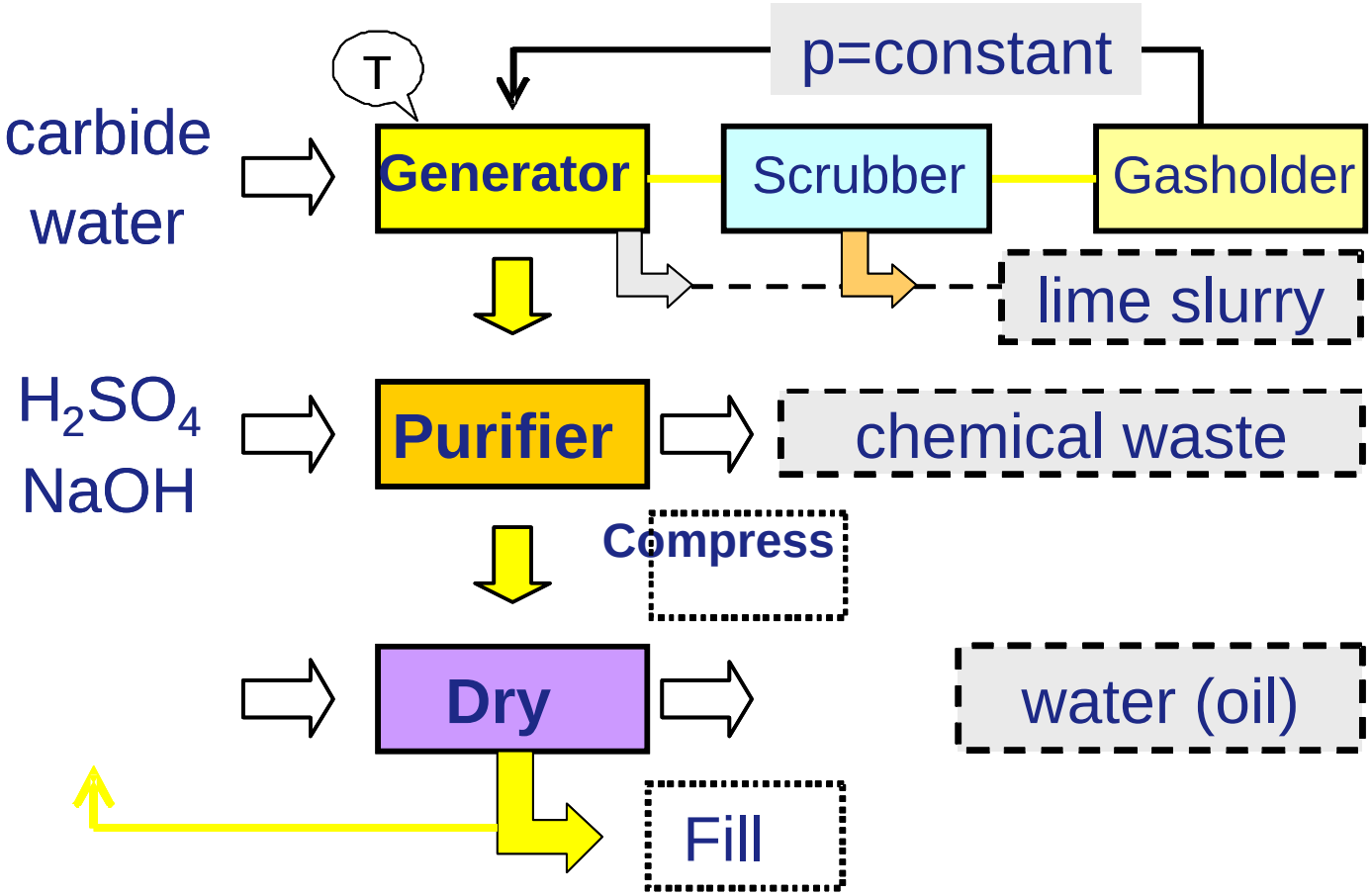
Generator | Purifier | Dryer

$$CaC_2 + 2H_2O = C_2H_2 + Ca(OH)_2 + \text{heat (!)}$$

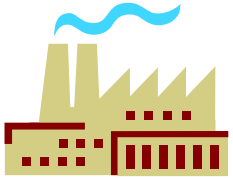
CaC_2/C_2H_2 (kg/kg): theoretical => 2.46

practical => 3.1(1)

Technology

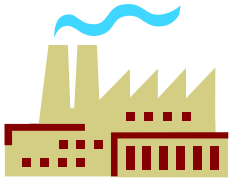

p=constant
T
carbide
water
Generator
Scrubber
Gasholder
lime slurry
H_2SO_4
NaOH
Purifier
chemical waste
Compress
Dry
water (oil)
Fill

Generation



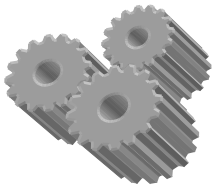
- **Operating pressure**
  => LP < 0.2 bar, MP, ~~HP~~
  (low press.) **(medium press; high press.)**
- **Operating method**
  => batch, semi-continuous, continuous
- **Gasholder (LP, constant pressure)**
  => production rate

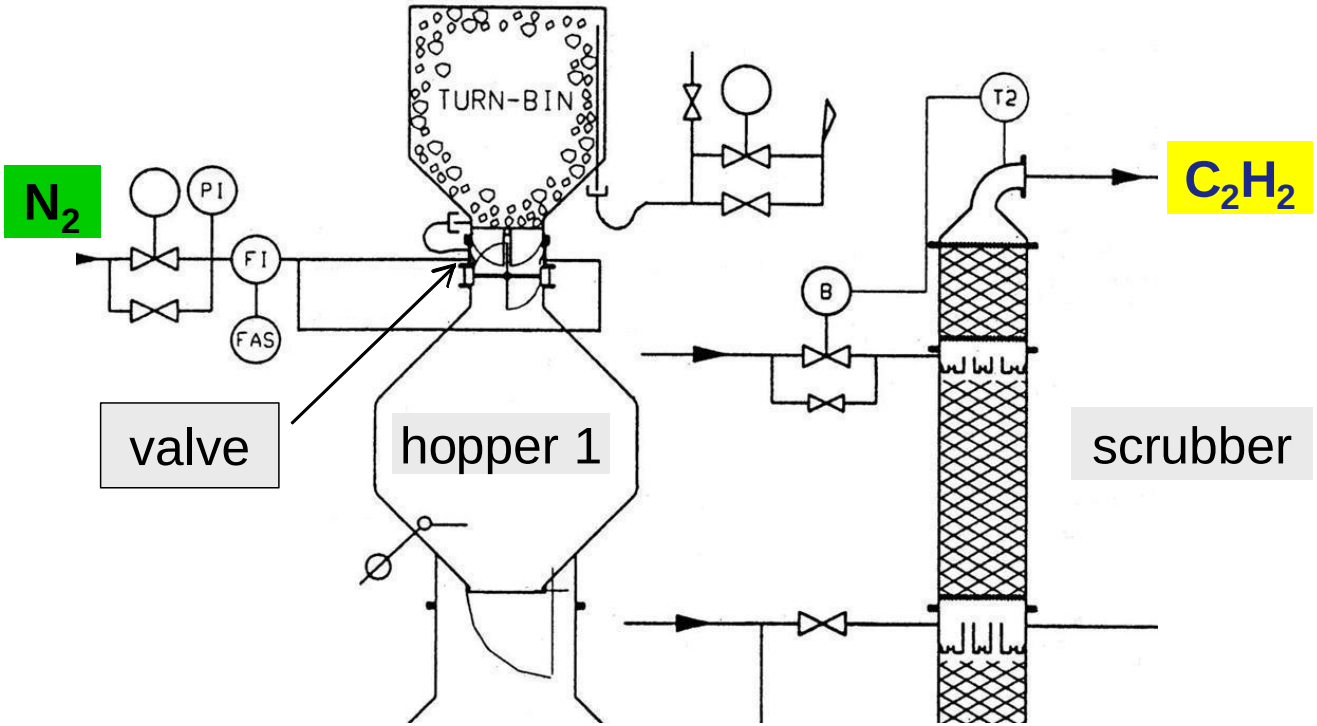
Generation (2)



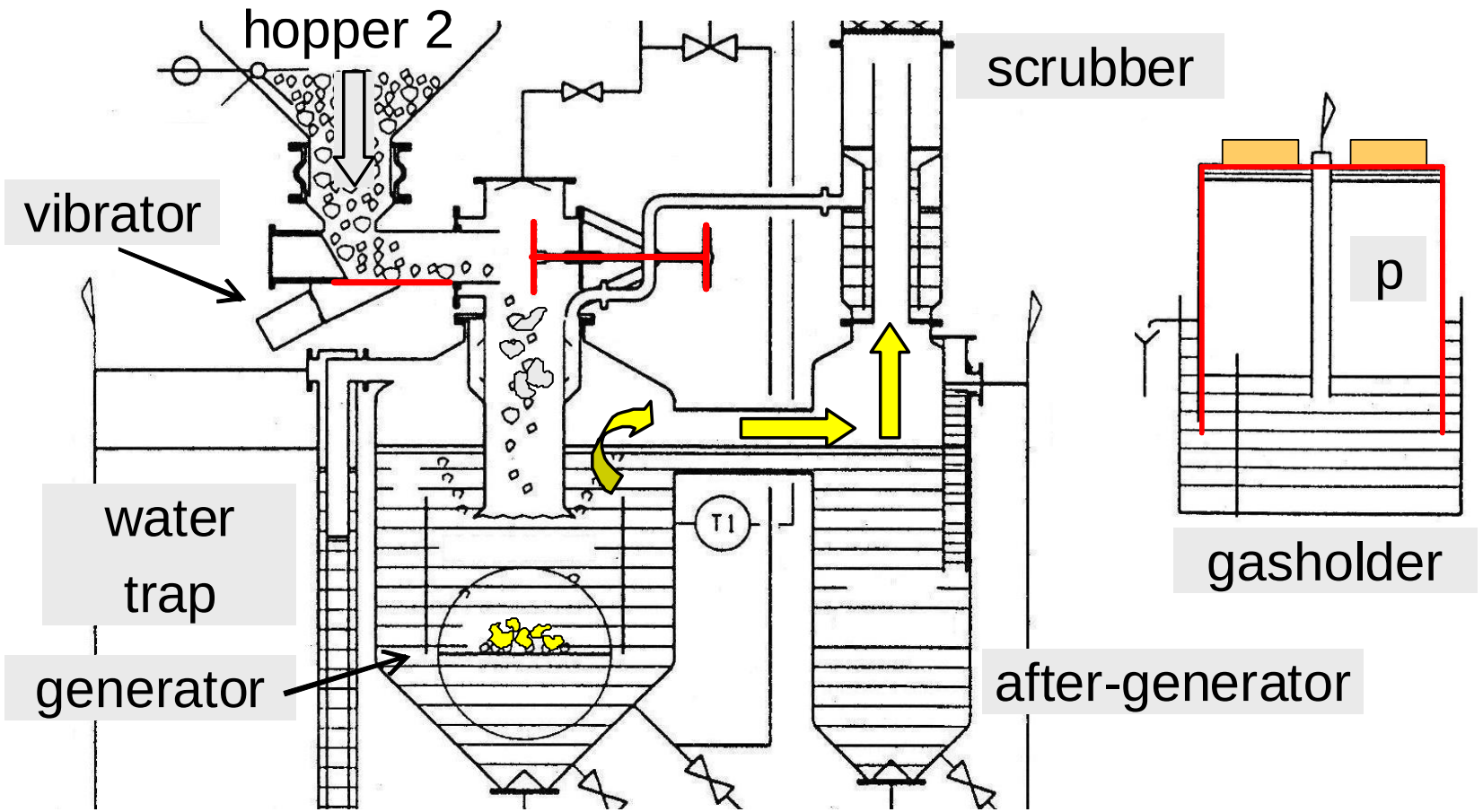
- **Buffer (MP, medium pressure)**
  => production rate
- **Pressure relief devices**
  => overpressure
- **Control of pressure, temperature, water level**
- **Safety: nitrogen purging**

Low pressure generator

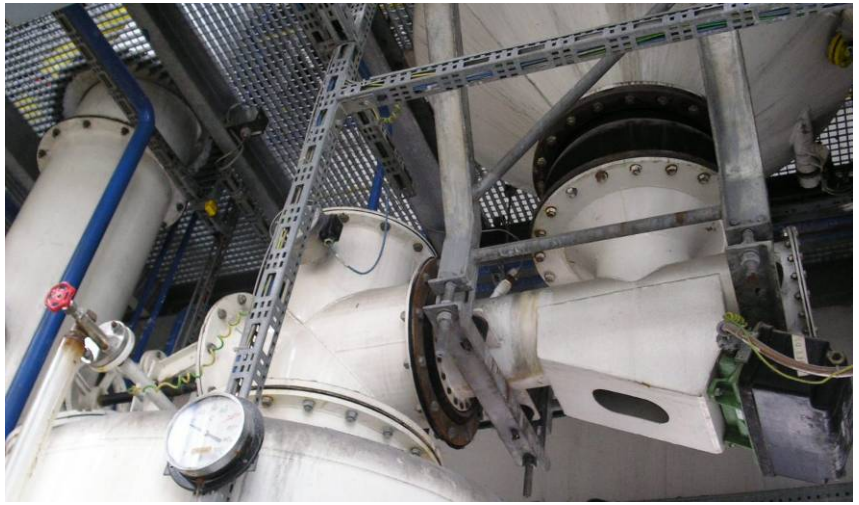




Low pressure generator (2)

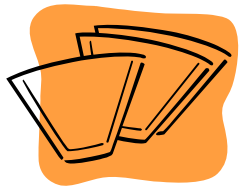


Example of LP generator



- carbide load: 1800 kg
- working temperature: 60° C - 90° C
- working pressure ≅ 35 mbar

Purification



- Impurities: phosphine, hydrogen sulphide, ammonia, water, air, oil and nitrogen
- Acetylene quality:
  - no purification => > 98.0 %
  - purification => > 99.6 %
- Tests demonstrated improved welding and cutting quality
- Impacts: reduced cylinder capacity (compounds); impurities per filling: 1 g/cyl.

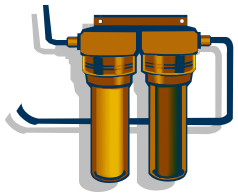
Purification Technologies

- **Wet purification**
  - **CaC_2 => H_2S, NH_3, small particles => scrubber (water)**
    => PH_3, H_2S => chemical purifier
  - **SiX => lime, residual: H_2, O_2, N_2, CO_2,…**
    (Silicate compounds)
  - **Environmental advantage**
- **Dry purification**
  - **acidic purifying compounds**
  - **impurities oxidized or absorbed**
  - **finite lifetime, disposal**

Example of wet purification

Example of dry purification

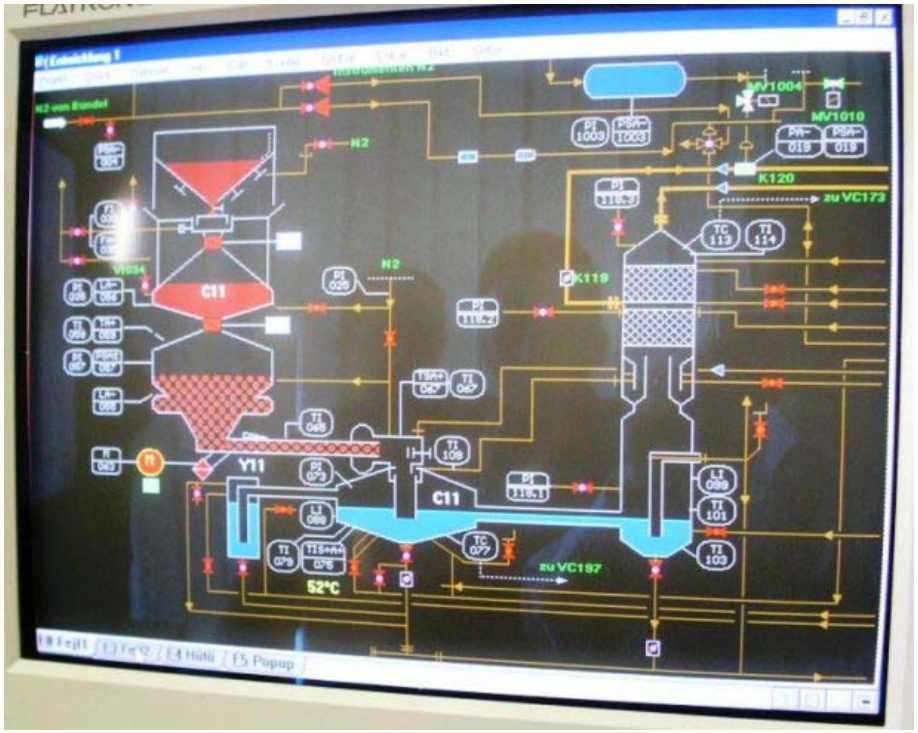
Drying



- Calcium chloride
- Silica-gel
- LP: large vessels, labour intensive, disposal
- HP molecular sieves (2 absorbers, alternating)
  - HP (max. 25 bar): more efficiently
  - regeneration gas: C_2H_2
  - dew point < - 50 °C (40 ppm)
  - reliable, automatic, but expensive, no waste

HP Dryer (Hafner)

Automatic control

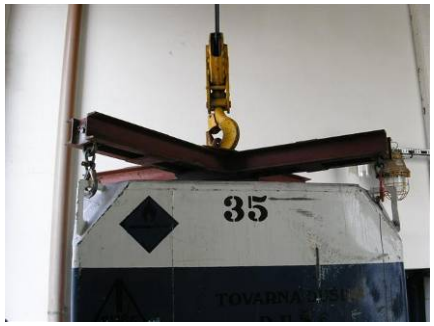


production parameters

C_2H_2 thresholds

Carbide & lime slurry

container carried by crane



“ferro” basin

slurry basin

Production yield

Improve acetylene yield by

- Correct carbide quality & granulation
- High generator temperature (> 70° C)
- Efficient cooling C2H2 (scrubber)
- Good water control
- Constant production
- Balance: generating ⇔ filling cylinders

Incidents

Slurry deposition:
- scrubber
- pressure raised
- overflow of slurry

“added value” to carbide container: shovel for carbide!
- vibrator blocked

Conclusions & Outlook

- **Advanced technologies**
- **Safe equipment**
- **Regular training for employees**
- **Pay attention to details!**

Thank you !