UN environment

Preventing and mitigating environmental and public health impacts in associated gas processing and treatment

Module 2

Summary description of module

An overview of associated gas: environmental and social liabilities of associated gas treatment

- Best available technologies to prevent and/or mitigate potential environmental and public health impacts of associated gas processing and treatment
- Waste sources and contingency planning, i.e., sulfur
- Case studies

Objectives

- Describe environmental issues/concerns at each stage of associated gas production process, including possible impacts on social, health, and safety
- Identify major causes for waste
- Categorize types of waste resulting from processing itself and the industry in general
- Identify possible solutions to reduce and eliminate air emissions
- Understand basic principles of contingency planning for accidental gas leaks and other related pollution incidents

Environment definition

It’s all about components of the earth:

- Atmosphere
- Land
- Water
- Plants
- Animals
- Other living organisms

Pollutant definition

- A substance or type of energy with adverse environmental effects
  - Air: e.g., SO_2, NOx **"possible waste streams, locations?"**
  - Land: e.g., spills of toxic material, waste
  - Water: e.g., petroleum products, sewage

Air pollution, human-made or natural

- Anthropogenic
  - Introduction of harmful materials into the atmosphere through human sources
- Common Industrial Stationary Emission Sources (Alberta)
  - Gas processing plants
  - Refineries
  - Power generation plants
- Natural sources
  - Natural sources of air pollution also exist (e.g., volcanic activity)

CEMS vs Ambient monitoring
High concentration vs Low concentration

- CEMS continuously measure emissions from stationary sources
  - Example measurements include: SO_2, NO_x, CO_2, O_2, TRS (total reduced sulfurs), PM (particulate matter) **"possible waste streams, locations?"**
  - Typical concentration measurements in ppm or percent
    1. 1% = 10,000 ppm
  - Mass emission calculation is also common (e.g., tons per day of SO_2)
- Ambient monitors measure surrounding conditions, the result of one or more emission sources in the area
  - Ambient measurements are much lower in concentration (ppb is common), 1000 ppb = 1 ppm

Concentration conversion summary

To Convert From	To	Do This
Percent (%)	Parts per million (ppm)	Multiply by 10 000
Parts per million (ppm)	Parts per billion (ppb)	Multiply by 1000
Parts per billion (ppb)	Parts per million (ppm)	Divide by 1000
Parts per million (ppm)	Percent (%)	Divide by 10 000

Table 1. Concentration unit conversion. Adapted from Instrument Technician ILM, Environmental Monitoring – Part A, 310404cA, (2019)

Pollution dilution: get it high in the air to disperse

- Stacks release effluent at high velocity and distance above grade
- Pollutant mixes with ambient to lower the concentration and disperse pollutant
  - Occasionally a temperature inversion occurs where cold dense air is trapped below warm air
  - This may result in less dispersion and a resulting pollution haze forming
- Ambient air monitoring ensures dilution and dispersion methods are effective for local emission sources

Stack gas plume

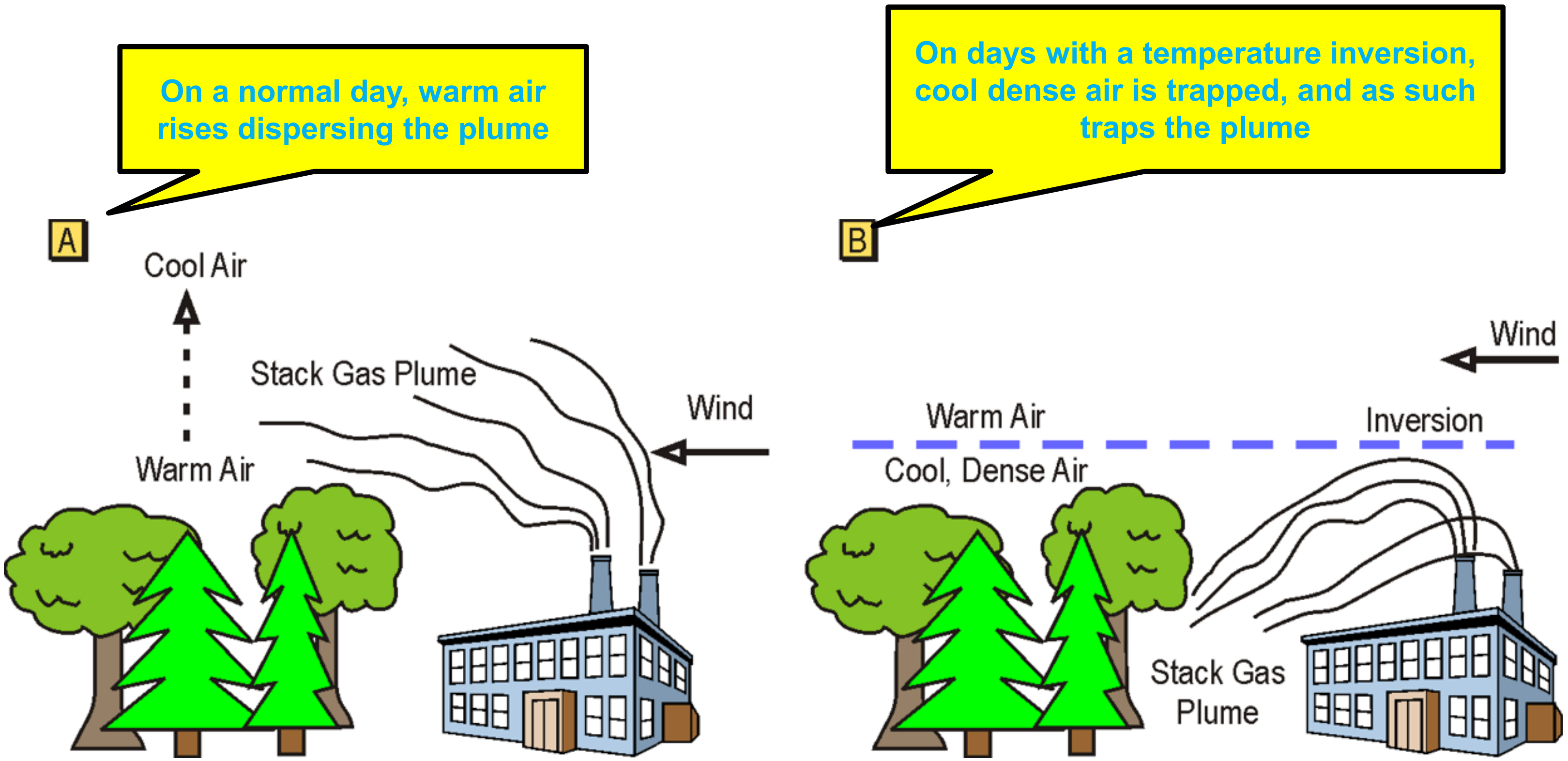


Figure 2. Industrial air quality management. Adapted from Instrument Technician ILM, Environmental Monitoring – Part A, 310404cA, (2019)

Calgary during temperature inversion

Figure 3 Smoggy Calgary Temperature Inversion (Buracas, 2008)

Contingency plan

- Emissions must be taken care of during design stage. Minimum and maximum possible emissions should be identified, and a contingency plan should be in place
- Upset process conditions resulted in emissions increase should be fixed and updated during design, construction, and operation phases
- SOPs "standard operating procedures" should be in place for better monitoring and mitigation techniques. SOPs are living documents and should be updated as per operation variables

Safety approach

- Safety is everybody's responsibility
- Instrumentation list to assure safety should be developed during design phase. Those instruments are listed for both the operation itself and the housings (e.g., buildings). Some examples are CMES (will be covered in module 3), SOx, NOx, CO_2, etc… measuring instruments
- PPEs are NOT enough to assure safety

BAT: Best Available Techniques for mitigation, re-use and safety approaches – continued

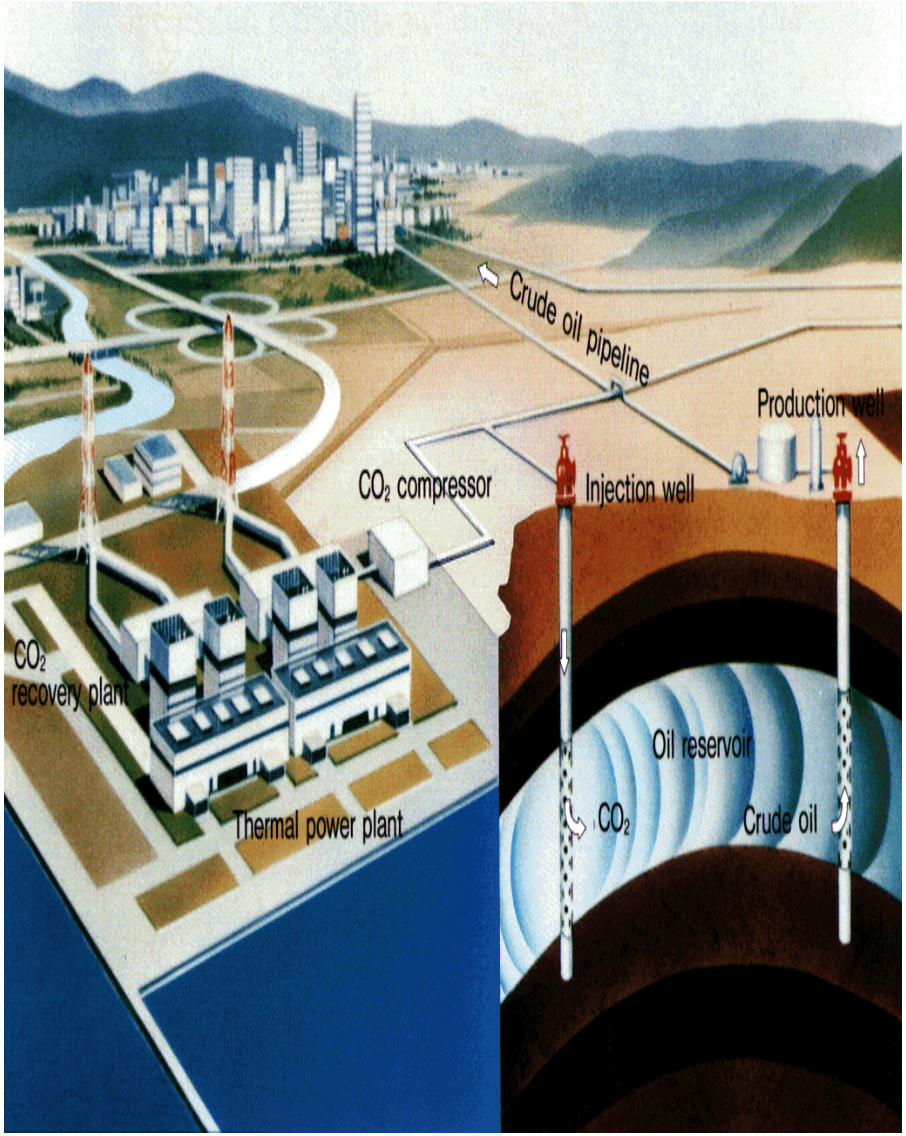
- As indicated in Module 1, waste in general has now profitable solutions. The choice of BAT depends on the waste stream handled
- Examples:
  - CO_2 can be captured and re-used in different applications, e.g. methanol production
  - SO_x: sulfur reduction by producing powder sulfur and sulfuric acid
  - NO_x: re-injection

BAT: Best Available Techniques for mitigation, re-use and safety approaches – continued

- Case Study:

CO2 capturing and re-injection

- Reason for Re-Injection: increase the oil well pressure " EOR-enhanced oil recovery method"
- Source of CO2: Amine Unit
- Introducing new Solvent
- Collection, Cleaning, Pressurizing, Piping, and re-injection



Main take-aways

- What are the major waste streams from associated gas operations?
- Where in the process can waste be propagated?
- Mitigation plan to minimize chances of environmental issues
- What safety precautions need to be in place?
- BAT: Best Available Techniques for mitigation, re-use, and safety approaches