CHEN 455 Project
Inherent Safety and Chlorine in Water Treatment

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Outline

- Introduction
- Background
  - Uses of Chlorine
  - Properties of Chlorine
- Pasquill-Gifford Dispersion Model
- PHAST Simulation Program
- Steps to Reduce Harm from Chlorine Leak
- Real-Life Chlorine Leak Incidents
- Conclusion

Introduction

- Chlorine has been used for water treatment purposes for more than one hundred years
- It is cheap, it is safe, and it works
- Chlorine derivatives: gaseous chlorine and sodium hypochlorite

Background

Uses of Chlorine:

- Chlorine has a variety of uses in a water treatment plant

- It is used:
  - on water intake structures
  - for pre-filtration to oxidize metals
  - to kill algae and bacteria

Background

Properties of Chlorine:

- Chlorine molecule has a volatile nature
- It has the ability to combine with anything
- It contains toxic properties

Background

Properties of Chlorine:

- A greenish-yellowish gas that has a molecular weight of two and a half times greater than that of air

Chlorine Gas - Pale Green

Pasquill–Gifford Dispersion Model

- A method to estimate the concentrations of a release at different distances from the source

- Better alternative: Britter and McQuaid model

$$\sigma_x^2 = \frac{1}{2} < C >^2 (ut)^{2-n}$$

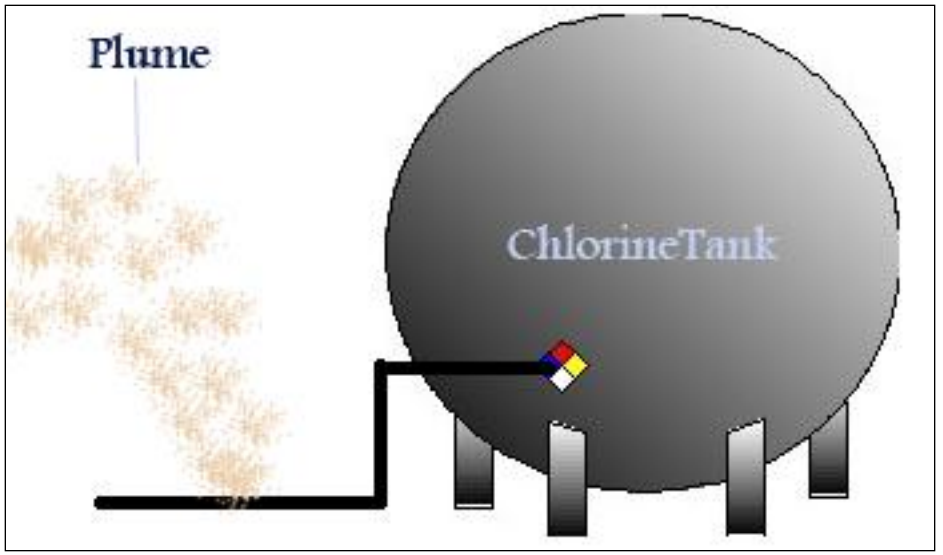
PHAST Simulation Program

- Provides planners and retrofitters with a tool to determine various levels of risk
- Contains more than one thousand and six hundred chemicals and covers the results of leaks, ruptures, and equipment failure
- Unified Dispersion Model

PHAST Simulation Program

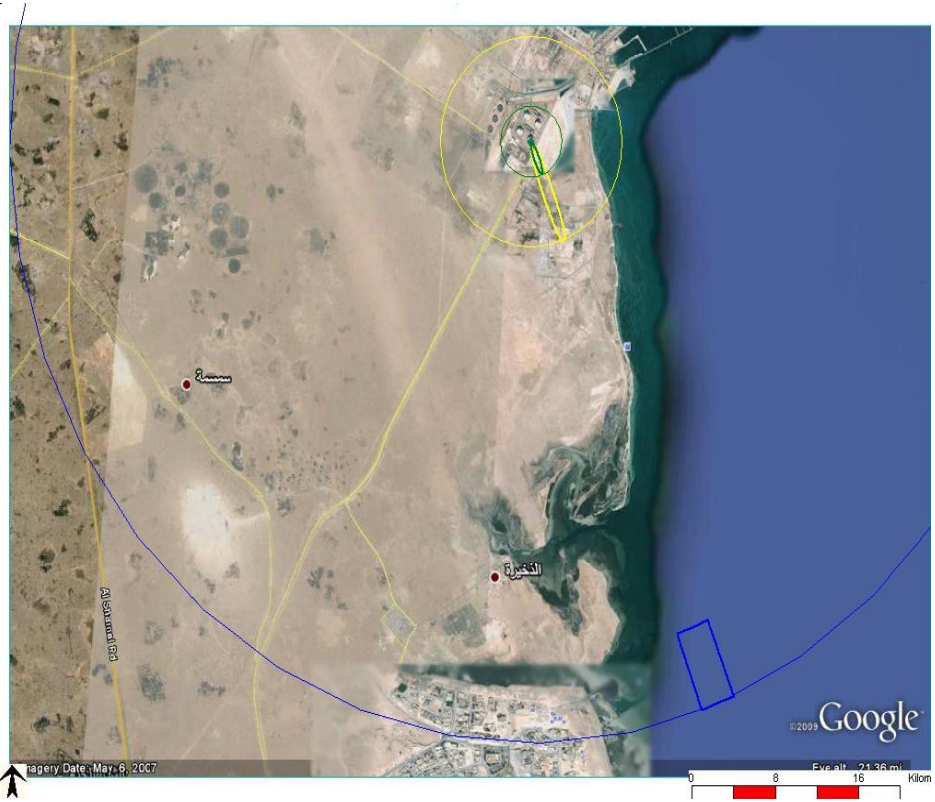
- Ras-Laffan & Al-Khor

- System Assumptions:
  - V=17.61 m^3
  - Pipe D=10 cm
- 3 Different cases:
  - Normal Day
  - Worst Day
  - Winter Day
- Continuous plume
  - 1ppm



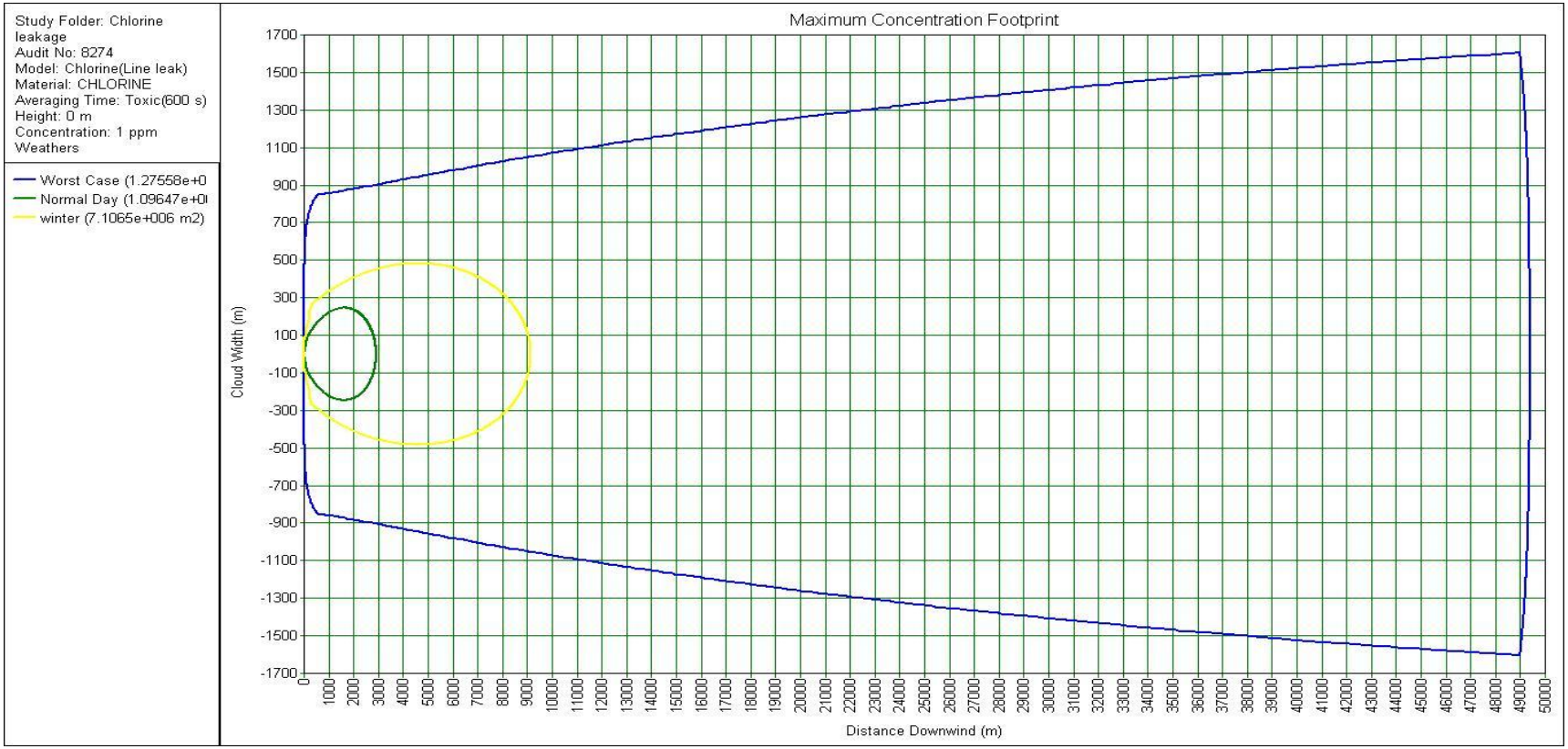
PHAST Simulation Program

- Wind Direction and Gas Dispersion



PHAST Simulation Program

- Maximum Distance for 3 Different Cases



Steps to Reduce Harm from Chlorine Leak

- Plant Location
- Maintenance & Safety Drills
- Chlorine Gas Scrubbers
- Vacuum conditions
- Simple Ammonia check

Real-Life Chlorine Leak Incidents

- Ontario incident
- Southern California incident

Conclusion

Chlorine is by far the cheapest chemical to use for water treatment, the most widely accepted, and has the fewest risks to public health.

- Rail transportation of chlorine presents the biggest risks
- Alternatives: UV treatments, nanofiltration, and modular ozone generation.

Thank you for listening to our presentation!